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Monday October 27 at 8.15 p.m.

AN INTERNATIONAL EXPEDITION TO ANTARCTICA. *By Capt. John Giaever and G. de Q. Robin*

Monday November 3 at 5.30 p.m.

KOREA THROUGH THE YEAR. *Kodachrome films with commentary by William Courtenay*

Exhibition

During November a small historical exhibition of Chinese Maps will be on view in the Galleries.

Thursday November 6 at 5.30 p.m.

FILMS FOR GEOGRAPHY TEACHERS. (*Subjects to be announced*)

Monday November 10 at 5 p.m.

TECTONIC RELIEF. *By Professor C. A. Cotton*

Monday November 17 at 8.15 p.m.

KIMBERLEY DIVISION OF N.W. AUSTRALIA. *By the Rt. Hon. the Lord Rennell of Rodd*

Monday November 24 at 5.30 p.m.

EAST AFRICAN JOURNEY. *Kodachrome films with commentary by G. C. Schluter*

Monday December 1 at 5 p.m.

DEPTH OF POLAR ICE CAPS. *By G. de Q. Robin and J. J. Holtzscherer*

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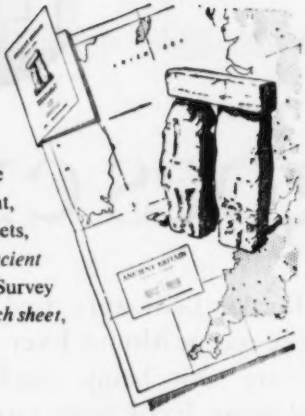

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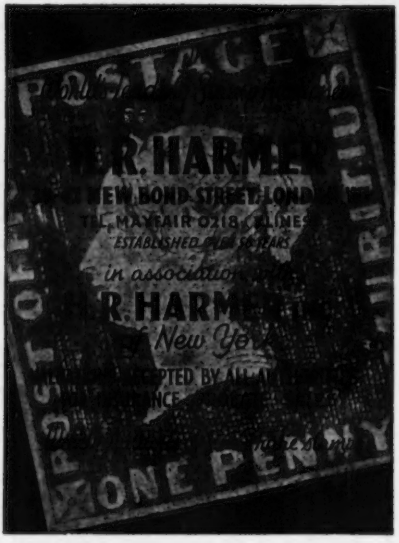

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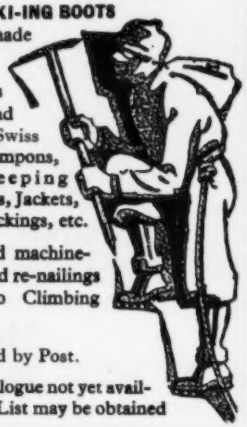

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The
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Vol CXVIII Part 3 *September* 1952

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J. M. WORDIE, C.B.E.

IT IS MY duty to announce that Her Majesty the Queen has been graciously pleased to grant her patronage to the Society and to continue the award annually of the Royal Medals. I should like to recall that the Society has enjoyed the royal patronage ever since its foundation in 1830, and each year we have the privilege of recommending candidates for the two Royal Medals—the Founder's Medal, which bears the effigy of King William IV, and the Patron's Medal, with the effigy of the reigning sovereign.

During the past year the Society has continued to prosper and it may be noted in particular that there appear to have been larger attendances at the evening meetings than in any other period since the war. The outstanding meeting of the year, on 4 February 1952, was Mr. Shipton's account of the 1951 reconnaissance of the southern approaches to Mount Everest; and the demand for seats was so great that the lecture had to be repeated to a packed audience on the evening following.

As in previous years, our aim for the evening meetings has been to cover as wide a field of interest as possible; not only to deal with exploration in different parts of the world but also to present other aspects of geographical work. The polar regions have naturally been prominent, in the Antarctic with M. Liotard's account of the French explorations in Adélie Land, and in the Arctic with Commander Simpson's and Mr. P. D. Baird's descriptions of their work in north-east Greenland and in the Canadian Arctic respectively. But other lectures, such as Mr. Shipton's, Dr. Donald Thomson's paper on Arnhem Land, M. Herzog and M. de Noyelle's dramatic story of the conquest of Annapurna, and Dr. Herdman's account of his oceanographical explorations in *Discovery II*, have preserved the balance, having in mind of course the greater possibilities today in the polar field for exploration on a large scale. In contrast we have had a stimulating and original paper by Lord Verulam on the world demand for electric power and on the possibilities of transfer of energy across national frontiers; and finally a paper of much topical interest on Inner Asia by the distinguished American orientalist, Dr. Owen Lattimore.

The afternoon meetings, which at present attract smaller audiences but in which University students are prominent, were all of them followed by

vigorous debate; and they included an innovation in the form of a joint meeting addressed by the leaders of three University expeditions to Spitsbergen. Film meetings, which included this year a visit from Mlle. Ella Maillart to show her remarkable films of Nepal, were as popular as ever; and as in previous years, our special programmes of geographical films for teachers, with opportunities for discussion and criticism, were much appreciated.

The Christmas meetings and the Christmas Exhibition have in recent years become prominent features of the Society's programme. The meetings in fact have become so widely known that applications for tickets from non-Fellows, which must of course be refused, are as numerous as they are embarrassing. The first talk, "Jumbos and Jungles" by Colonel Williams, better known as "Elephant Bill", produced a variety of diverting and unexpected questions. In contrast, Ponting's original film on Scott's Last Expedition proved as fascinating to a youthful audience as it had already been to the Fellows, who had seen it at the Society last Summer as part of the celebration of the Festival of Britain. The Christmas Exhibition did not, as has been usual, link up directly with either of the children's meetings. It seemed more appropriate that the subject last December should be Mount Everest and its success was such that it remained on view for a period of nearly five months. The Exhibition covered the history of all ten expeditions made from this country since the original reconnaissance in 1921, and it illustrated for the first time the complete story of British endeavour in the specialized and physiological field of mountain exploration.

I should like to take this opportunity of thanking those members of the Staff of the Society concerned for their support in these activities, and for the admirable and efficient way in which they have contributed to the success of our lectures and meetings—and not least in the case of the exhibition.

Among publications it is still not possible to issue the *Geographical Journal* more than four times each year, and the number of pages, although the total cost is about the same, is now less than half what it was in pre-war days. This curtailment has resulted partly from the high cost of paper, partly from difficulties in printing. These difficulties have also affected our other publications, but in spite of them progress has been made in certain directions. The second of the new series of Research Memoirs, Dr. Jennings' monograph on the origin of the Broads, is on the verge of publication. The third of the memoirs, by Mr. W. V. Lewis of Trinity College, Cambridge, is in preparation, with the assistance of a grant from the Royal Society, and will deal with his glaciological studies in Norway. The Librarian and Map Curator, Mr. Crone, has published under the Society's auspices, a booklet outlining the progress of modern geography since A.D. 1800, based on articles originally contributed to the *Geographical Magazine*, each one focussed on a central figure in his period. An important event, after the long delay imposed by the war years, was the publication of the 'Fifth General Index to the Geographical Journal,' covering the period from 1933 to 1942. The publication of the bibliographies of new geographical literature and maps was also resumed, on a twice-yearly basis and in an expanded form from that of pre-war days. The value to libraries and many other organizations of this up-to-date and annotated reference list is, of course, very considerable and no comparable publi-

cation in printed form, and including lists of maps, exists. Finally, a start has also been made on a new edition of 'Hints to Travellers' which will be in three volumes instead of, as now, in two.

Of the two international congresses in which the Society is more particularly interested one met last year, the other will meet this autumn. The International Union of Geodesy and Geophysics held its Congress in Brussels in August 1951. Among the activities which may be chosen for mention were those of Oceanography presided over by Dr. H. U. Sverdrup, and of Hydrology, where I was myself responsible for the Snow and Ice Commission in succession to Professor H. W. Ahlmann and will in turn be succeeded by Mr. Gerald Seligman as Chairman.

This August, the International Geographical Union will hold its Congress in Washington, D.C., and our Honorary Secretary, Mr. Brooks, and myself are attending to represent the Society both there and at the Centenary Celebrations of our sister Society, the American Geographical Society of New York. The Society particularly welcomes the Centenary of the American Society, and is sending a special address to mark our appreciation and friendship. One of the features of the Washington Congress will be exhibits of the cartographical work of many countries. The British exhibit, which has been coordinated by the Society's staff, will be the most comprehensive of its kind yet organized, and in addition to contributions from the British Government survey departments will include specimens of the Society's work and a selection of exhibits, mainly atlases, from commercial publishing houses.

Among other Congresses not primarily geographical I should mention that Mr. George attended the Commonwealth Survey Officers' Conference in London last July, and that Mr. Kirwan took part in the International Congress of Orientalists as the Society's representative at Istanbul last September. Congresses this summer also include the International Congress of Anthropological and Ethnological Sciences at Vienna in September, when Mr. J. V. Mills and Mr. L. C. G. Clarke will represent the Society; the Fourth International Congress of Onomastic Sciences at Uppsala in August, which will be attended by Mr. Aurousseau; and the International Geological Congress at Algiers in September, when Mr. A. F. Martin will represent the Society.

It is my sad duty to record the losses which the Society and the world of geographers in general have suffered since last year's Annual General Meeting. Among these I particularly mention *Brigadier E. M. Jack*, who died in August 1951, and who had been a Fellow since 1908. He was awarded the Gill Memorial in 1916 for his work on the Uganda–Congo and Anglo–German–Belgian Boundary Commissions, and the Founder's Gold Medal in 1919. The latter award was made in recognition of Brigadier Jack having been responsible throughout the war of 1914–1918 for all the survey and geographical operations required by the British Army in France and Belgium; new methods were evolved including sound ranging. At the end of the war he was in charge of the greatest survey force ever employed, over 4000 officers and men, and their labours resulted in the largest survey operation in history, and by far the most important ever undertaken up till then from a national point of view. After the First World War he succeeded Sir Charles Arden-Close as Director-General of the Ordnance Survey. For many years a highly

valued member of Council, he served from 1921–1931 as Honorary Secretary, and from 1931–1935 as Vice-President of our Society. More recently a similar loss was the death of *Brigadier P. K. Boulnois* in February this year. Brigadier Boulnois had been an important member of Council for many years, and like Brigadier Jack had also held the post of Head of the Geographical Section of the General Staff, later known as the Directorate of Military Survey. Abroad, we have lost a distinguished Honorary Member in *Professor Bailey Willis*, the American geologist, formerly of Stanford University, California. Academic geography, too, has suffered a regrettable loss through the death from a fall on Mount Nimba in West Africa of *J. Richard-Molard*, Professor of Colonial Geography at the École Nationale de la France d'Outre Mer.

During the year the Council have been faced with the problem of how to finance the Society's activities in a period of rapidly rising costs. During the coming year a deficit is expected of between £3000 and £4000. The problem of how to increase our income has therefore been under review throughout the year, with the probability that it would be necessary either to introduce a system of covenanting or to increase the annual subscription, or to do both. It is now evident that an increased subscription is inevitable. The last increase took place in 1908, when the subscription was raised from £2 to £3. That it has remained unaltered for such a long period is due to the increase each year in the membership of the Society. The rise has been a steady one and it is interesting to notice that it has taken place at practically the same rate since the Second World War as it did following the First World War in 1918. It is possible therefore to forecast with fair probability the rate of increase in the fellowship. The outcome of a system of covenanting is less certain, but negotiations with the appropriate authorities are being actively pursued.

The Council propose therefore to summon a Special General Meeting in the autumn to secure the consent of the Fellows to proposals for an increase in the annual subscription from £3 to £4, and for this increase to be applicable to all Fellows except those who were Fellows before 1908. The Council have reached the decision to increase the subscription with much regret, but feel sure that Fellows will appreciate the necessity for the step and will continue to support the Council in its endeavours. In order to meet the wishes of many Fellows arrangements will be made for the subscription to be payable by means of half-yearly or quarterly instalments, provided this is done by Bankers Order.

At the same time it has been decided to bring forward a second resolution at the Special General Meeting to reduce the entrance subscription from £5 to £4. This will also be payable by a system of instalments.

A third resolution will also be introduced inviting Fellows who are eligible to do so to covenant over a period of seven years. This, if approved, will provide an appreciable increase in the income of the Society without any additional commitment being incurred by the Fellows who decide to covenant.

With these changes we should I think be able to balance our budget. If so, we shall be able to restore our activities—as is our duty as a learned society—to something approaching their pre-war strength. The number of meetings, evening, afternoon and films, will be increased, though the total will still be

below that of pre-war days. Our main source of spreading geographical knowledge is by the *Journal* and it is hoped to see it enlarged as soon as possible. The Council have had this matter under review with the intention of increasing the number of pages. This might as an alternative take the form of the *Journal* appearing in future every two months. Six numbers of the present size would represent a 50 per cent. increase, which even then would be not more than three-quarters of the pre-war size.

The year was marked by the return to this country and to Scandinavia of the Norwegian–British–Swedish Antarctic Expedition to Queen Maud Land, with which the Society, in cooperation with the Scott Polar Research Institute, had been closely concerned since the first tentative suggestions by Professor Ahlmann during the war, followed by definite plans put forward to the Society in 1946. It is, of course, too early to assess in any detail the scientific results of this great expedition, but it is already clear that its achievements both in science and in exploration will rank it as one of the most important in Antarctic history. Meteorological work included a full two-year series of observations, with some 650 *radiosonde* and *rawin* ascents. An extensive and up-to-date glaciological programme was carried out. Seismic observations of the thickness of the ice shelves and of the inland ice showed an unexpectedly thick ice cover in the interior from a 7000 to 8000 feet plateau height almost down to sea-level.

If I were to single out other prominent expeditions of recent date I would specially mention Mr. Shipton's reconnaissance of the southern side of Mount Everest last autumn. During the present spring the two most important expeditions in the field have been Shipton, again, on his attempt on Chooyu, and Mr. Duncan Carse on his pioneer exploration of the interior of South Georgia. Very shortly two other outstanding expeditions will take the field, Shipton yet again in the main attack on Mount Everest, and Commander Simpson, who will take an expedition to the interior of North East Greenland. The latter is an expedition which one welcomes very warmly indeed. It sees the revival of naval interest in the polar regions and for size can only be compared with Scott's last expedition to the Antarctic in 1910. The party is predominantly supplied by the three fighting services, with the Navy in the lead, but the Merchant Navy also plays its part and there is also a stiffening of scientists and others from the Universities. I should like to add that the financing has come in the main from certain oil companies interested in the training possibilities and that if it had not been for their generous action it would certainly not have been possible to launch the expedition even as a smaller venture. It will now leave this country fully staffed and with the most up-to-date equipment, and it can well be described as likely to become the most important Arctic expedition from this country since 1875.

Before closing I should like to speak of our support of exploration in general. The last two to three years have seen a welcome expansion of exploring expeditions. These have been of the traditional types, either large expeditions with public help or small private ventures. In the last few years however the private venture has become prominent in a way that was not perhaps unexpected, for there has grown up a lively interest in summer exploration at many Universities both in England and in Scotland. Before the war

adventures of this sort were as a rule confined to the three large Universities, Oxford, Cambridge and London, but they have now spread over a much wider field. The Society particularly welcomes this development. As in the past, the parties include among their personnel scientists of all types, geographers, geologists, archaeologists, biologists and others. The Society has always taken a very wide view of the activities which it can support and is prepared to give its blessing to all forms of scientific exploration, as has been its custom throughout its 120 years of existence. We naturally give priority to expeditions with a predominantly geographical flavour, but at the same time we think it right to encourage today, as in the past, those who, like Francis Galton in Africa, or H. W. Bates and Alfred Russell Wallace in the Amazon basin, or A. F. R. Wollaston in New Guinea, have other, and in these particular cases biological, as well as geographical interests.

THE GEOGRAPHY OF POWER: ITS SOURCES AND TRANSMISSION

THE EARL OF VERULAM, J. HOUSTON ANGUS AND S. CHAPLIN

IT MAY BE said that the industrial civilization of the West is today increasingly dependent on the availability of power, in towns and cities, in villages and farms, in the service of communication and travel, at the point of production in manufacturing industry, and in almost every form of mining and agricultural activity. In Europe today the pursuit of productivity, or of production per man hour as it is sometimes called, is regarded as the royal road to economic solvency. High production in industry, agriculture or mining is however no longer possible without the ready availability of power, generally electric power, at the elbow of the operative but drawn from a distant source beyond his ken.

The immediate availability of power to a community is a measure of its prosperity, or potential prosperity. At the present time the average industrial worker in the United States of America is said to consume more than 7000 kWh. in the course of one year; the corresponding figure for the United Kingdom is said to be around 2300 kWh., or one-third only of the American figure. The kilowatt-hour is of course the standard unit in which electric power is measured, bought and sold throughout the world. Ten 100-watt lamps require a kilowatt to keep them alight and they burn one kilowatt-hour of electrical energy in one hour.

Figure 1 illustrates the relative power consumption in kilowatt-hours per head of population in 1947, for those countries of Europe for which figures were published in the Statistical Year Book of the World Power Conference (No. 5). A conical projection has been used and the national boundaries are the political frontiers prevailing today. The figure represents diagrammatically the total electric current sent out to systems or "Grids" (and not privately generated); the figures for population being those estimated for the same year by official sources in the countries concerned, and quoted in the same report. It will be seen that the incidence increases from a figure of less than 500 kWh. in the case of fourteen of the countries shown, to 2314 kWh. per person per annum in the case of Norway. Countries for which figures are not published in the World Power Conference Year Book are shown in white.

Norway leads Europe because of the small size of her population, the mountainous nature of her territory and the wealth of streams and rivers tumbling down to her coastline, many of them fed by inexhaustible reserves of water stored at a high level as snow or ice. Switzerland and Sweden are next in importance, each of them blessed with the energy of falling water, each of them harnessing from that water and feeding into their respective systems more than twice the amount of electrical energy per unit of population than is available in the United Kingdom—the fourth European country in

order of importance in this respect. It is significant that Switzerland and Sweden, whilst their populations are only 4·5 and 7 millions respectively, have become the homes of electrical plant manufacturing concerns whose size, past record and current achievements must place them amongst the first ten such undertakings in the whole world. On the achievement of these two

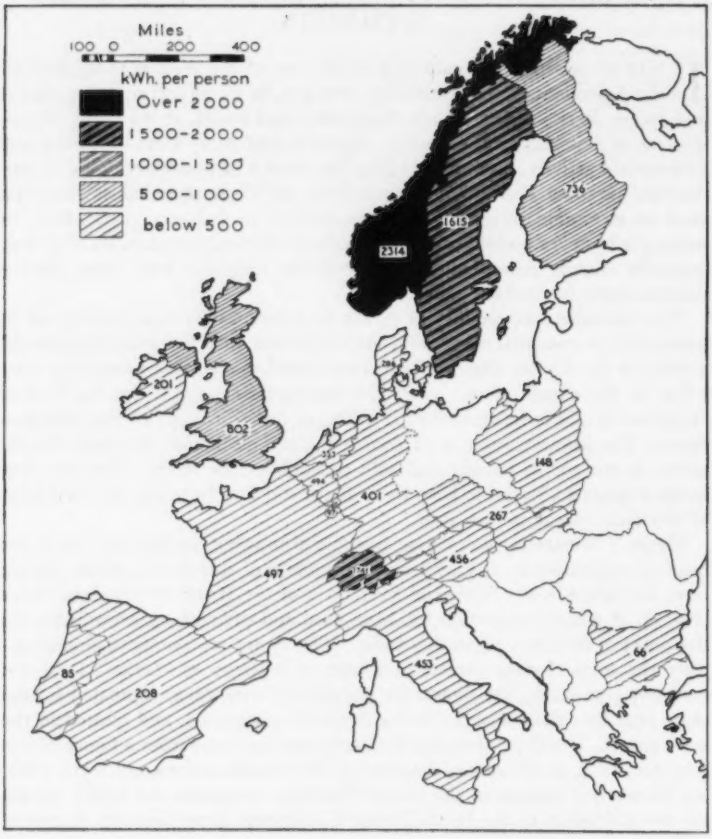


Fig. 1. Consumption of electricity per head in Europe, 1947

undertakings depends to a very large extent the sustained high standard of living that these two countries have attained and which they maintain.

In considering the importance of this map we must note that Britain's consumption of 802 kWh. per person per annum is the highest for any of the countries dependent mainly on thermally generated power, in other words on the use of the steam produced by the combustion of coal and used to drive a steam-turbine (itself the invention of a distinguished Englishman, Sir Charles

Parsons), which in its turn must drive a generator. It is also much the highest figure for any of the countries having large populations. Finland, like Norway a country with immense resources of water-power and a large land area, is fifth on the list. France and Belgium are shown on this map as belonging to the lowest category; in fact, they both come very close to the 500 kWh. per

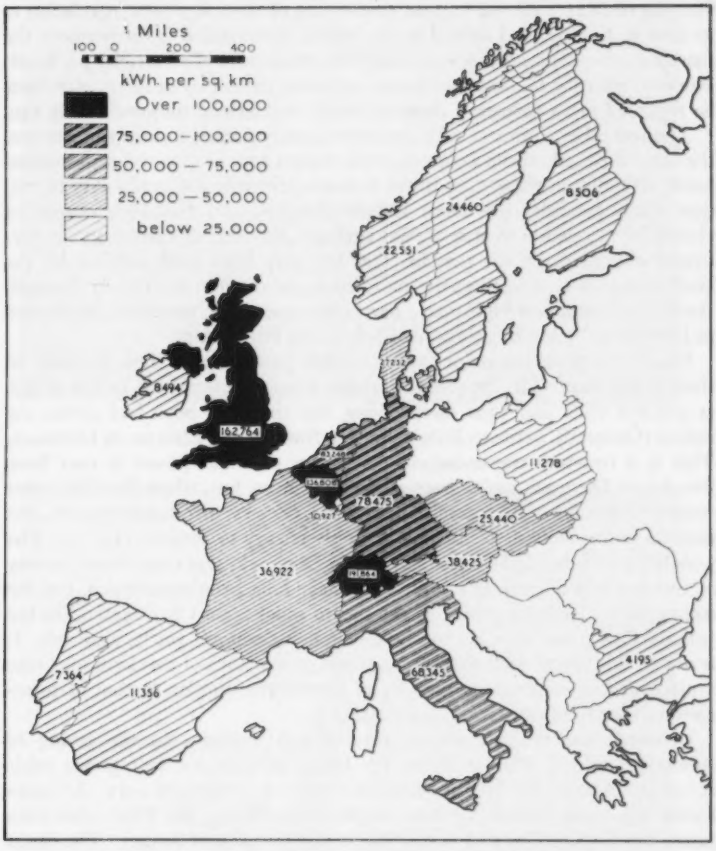


Fig. 2. Consumption of electricity per square kilometre, 1947

annum mark, which would have brought them into the same category as Finland and the United Kingdom.

It is necessary also to consider the availability of power in relation to the area of the territory in question, no less than to its population (Fig. 2). The sources used, the scale and the method of preparation for the two maps are identical. In this case the cross-hatching represents the total current sent

out to systems in kilowatt-hours per square kilometre of surface area (lakes and rivers included) in the same year, 1947. The density increases from less than 25,000 kWh. for the nine countries in the lowest category to 192,000 kWh. per square kilometre per annum for Switzerland.

It is surely not without significance that Switzerland, the country with the highest standard of living and the "hardest" currency in Europe today, is also the country with the highest production of electric power in relation to its area in Europe, and indeed in the world. Switzerland is furthermore the European country with the second highest production of electricity per head; Norway, with the highest production per head, cannot by ordinary standards be regarded as an industrial country, while Switzerland unquestionably can.

The two other countries with the most densely packed industry in Europe, the United Kingdom and Belgium, come second and third on this same assessment, although in either case it was perhaps primarily the availability of coal that made possible this dense industrialization, and this high output of electricity in relation to area of land surface. No other country calls for particular comment, except perhaps that the very high level reached by the Netherlands is noteworthy, the more so as production is entirely thermal. Italy, too, occupies a high place, partly because of the resources, unrivalled in Europe, of hydraulic energy available in the Italian Alps.

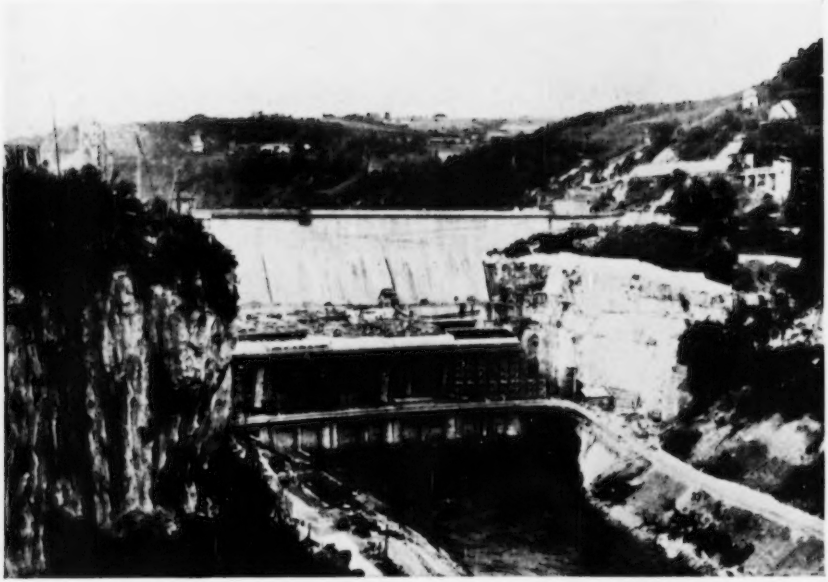
Many European countries export electric power across their frontiers to their neighbours. The biggest submarine power transmission in the world, at 132,000 volts and 5500 metres long, has this year been laid across the Sound (Öresund), between Hälsingborg in Sweden and Elsinore in Denmark. This is a two-way transmission; the energy of water power is sent from Sweden to Denmark under normal circumstances, but, when Swedish water resources are low (on account of drought or very low temperatures), the thermal power stations of Denmark supply energy to Sweden (Fig. 3). The possibility of other links from Norway to Denmark, and even from Norway or Sweden (via Denmark) to Germany, have long been entertained, but the technique for carrying power across the 70 miles from Christiansand to the Jutland Coast, and then across the Great Belt, may not yet be available. It is not an idle speculation that international power links of this kind may take a place in the economic geography of the future, similar to that of international trunk railways, roads and canals.

Denmark has recently shown further real initiative in the laying of submarine cables. Plate 1 shows the laying of a 60,000-volt power cable across the Alsund, in the south-eastern corner of Jutland, in 1951. A Conan Drum was used, similar to those employed for laying the Pluto pipe-lines across the English Channel at the time of the invasion of France. The drum was towed by a small motor-boat only and a cable 2 kilometres long was laid by this method in precisely seventy-five minutes from shore to shore. For longer lines, and in the open sea, it is likely that cable-laying ships will be used for work of this kind, the cable being coiled in the hold of the ship.

Norway possesses great resources of hydro-electric power, more power than the country will require for its own needs in the forseeable future. It is noteworthy that it is in the south-west corner of the country that the unwanted potential is relatively large. The distance from Egersund in south-west

1. Laying the power cable across the Alsund

2. Exhibits in the Society's Galleries, December 1951



3. The power station under construction at Génissiat, 1948

4. The syphon at Harsprånget, Sweden

Norway to Berwick-on-Tweed is of the order of 380 miles. It is likely that, within the next twenty years, the transmission of power by cable across such distances will be a practical possibility. If that happens, Norway will possess a new exportable asset; she has few today. Transmission from new hydro-electric stations in Iceland to the North of Scotland would also become possible, and technically practicable subject only to economic considerations.

In Sweden, a similar situation exists, except that Sweden has already harnessed much of the available energy of her southern rivers, and now looks for new resources in her Arctic North. At Harsprånget, the "Hare's leap" cataract on the Stora Luleälv, in the far north of Sweden, there is now being completed a hydro-electric station which houses the three largest generators yet built in Europe, with capacities of 100,000 kW. each. The river tumbles eternally over a series of rapids, some miles north of the Arctic Circle, at the point where the northern forests give way to tundra. A dam was built to hold back the water in order to provide a dry river bed for the construction of the main dam; the Swedish engineers constructed an aqueduct under the dam site and allowed the whole river to flow underground through it, leaving the site of the dam dry. Plate 4 shows the water sinking into this man-made siphon, to emerge again on the other side of the workings.

Fig. 3. The projected exchange of power in Scandinavia

The power station is built underground. The reasons for this are: to protect it against the low external temperatures in winter, to protect it against attack in time of war, to give the engineers the possibility of planning in three dimensions inside a world of rock, to give greater fall and thereby to increase output and efficiency, and to lower the overall cost. The station is a monument to Swedish constructional and engineering skill. It will not only help to solve one of Sweden's major problems but will also set a lead to the world in as much as the power is to be transmitted over a distance of 593 miles at a pressure of 380,000 volts, alternating current, the highest transmission voltage in the world. Sweden is showing, within her own borders, that greater things can be done than have yet been thought possible.

The fact that three water-driven turbines, the largest in Europe, can drive three 100,000 kW. alternators in the far north of Sweden, and thereby be made to feed with energy the industries of Stockholm, means that in other places in the world power could be brought from the inexhaustible but fixed sources of energy, where such exist, to the point of consumption—town or

city or factory—within the compass of techniques already known and proven today. The fixed and inexhaustible sources of energy include waterfalls, the swift flow of great rivers, winds, tides and subterranean or "geo-thermal" sources of heat. Transmission lines need not respect political frontiers made by man.

Figure 4, recently published by the Director-General of the Swedish State Power Board, shows the logical development of power lines in a country where 85 per cent. of the harnessable water power resources are located in

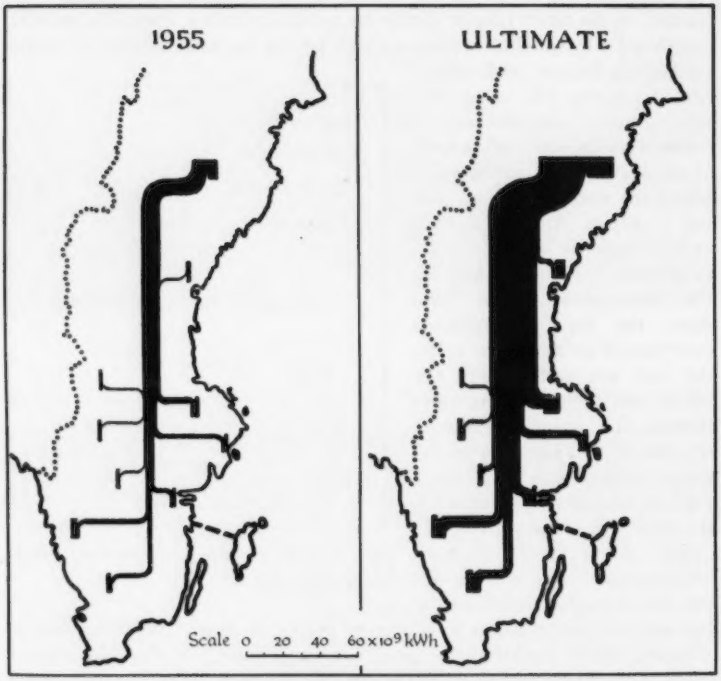


Fig. 4. Energy flow development in Sweden

the north of the country. A new submarine cable to be laid shortly from the mainland at Västervik to a point near Visby on the island of Gotland, a distance of some 60 miles, will carry over to the island power generated by falling water on the mainland, using direct current as the means of transmission. This will be the first direct current transmission of its size and type in the world and, if successful, will open new realms of possibility.

It is a matter of technical convenience that electric power is generated and used today in the form of alternating current. The advantages of alternating current do not unfortunately extend to the field of long distance transmission, in as much as its nature imposes definite limits to the distances over which

power can be conveyed, these limits being both technical and economic. In the case of overhead transmission lines, the limit for alternating current is reached somewhere between 500 and 600 miles; with underground or submarine cables, transmission begins to become uneconomic at 10 or 15 miles. If electrical energy could be generated as alternating current, converted into direct current before transmission and inverted back to alternating current at the receiving end of the line, transmission over distances of 1000 miles (and more if necessary) would immediately become technically possible, and the cost per mile in terms of capital outlay and of running charges would be substantially reduced. It is precisely this that the Swedish engineers are about to do between Västervik and Visby. It was this that the Germans achieved during the war, between Charlottenburg and Moabit on the outskirts of Berlin (a distance of 3 miles only), 4000 kilowatts being transmitted at 110 kV. The plant was installed by Siemens in 1941 and the experiments abandoned in 1943; in 1944 the Russians removed the plant in its entirety to the Soviet Union. Experimental work and designs by Swiss engineers have been at least equally important in this field.

To the geographer, as to the engineer, the harnessing of water-power on a vast scale must necessarily involve consideration of the problems presented by river valleys seen as a whole. A case in point is the Rhône Valley, from Geneva to the sea (Fig. 5), which with the rivers of its left bank (notably the Isère and the Durance), comprises the greatest reserve of unharnessed water-power in France. Under the Monnet Plan it is proposed to derive 13 milliard kWh. each year from the Rhône alone, an increase of 62 per cent. over the total electrical output of France in 1945. Ten of the twenty proposed stations are to be sited below Lyons, and ten above. The engineering works involved are still on the drawing-board, except for the plants under construction or nearing completion at Génissiat, Seyssel and Donzère-Mondragon. The station at Génissiat, some 30 miles down river from Geneva, is now the largest hydro-electric power station in Europe, west of Dniepropetrovsk in the Ukraine; and has involved the building of a dam 300 feet high, 460 feet wide at its summit, and 30 feet thick, in a gorge whose initial width was 170 feet. In 1946 no less than 10,500,000 cubic feet of concrete were laid. Four of the six turbines have so far been installed, each weighing 957 tons. The average flow of the Rhône at Génissiat is 380 cubic metres of water a second, and the largest known flow, at the time when the snows are melting, has been of the order of 2000 cubic metres a second. To handle such excess water, and to give an essentially French lightness and delicacy to a structure otherwise ponderous by reason of its very mass, a spectacular open-air spillway has been built to discharge the surplus water below the barrage. The great concrete chute passes below the main approach road to the dam, the water dropping 70 metres to the tailrace with a velocity of 15 metres a second, this final leap back into the Rhône adding the roar of mighty waters to the subdued hum of a great generating station.

The development of the full available power that can be harnessed in a great river must be considered in relation to navigation, to soil and water conservation, to flood-prevention, and to amenity or scenic beauty, each or all as the case may be. The most significant project of this kind today is the

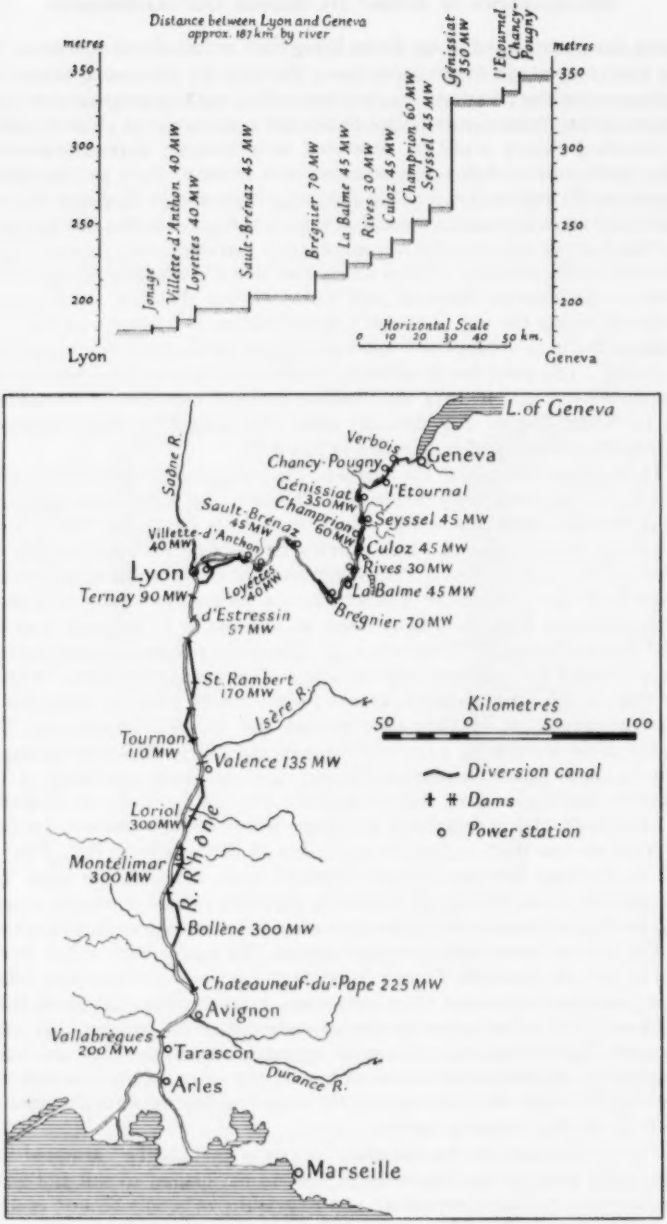


Fig. 5. Rhône valley power stations and the utilization of the available head

Great Lakes—St. Lawrence Deep Waterway (Fig. 6). The project is concerned in the first place with navigation, the opening of the Great Lakes to ocean-going ships; it is an international affair in as much as it lies along an international frontier. It is also to be a means of generating power on a vast scale; in the International Rapids Section alone, a total installed capacity of some 2,000,000 kW. of plant is proposed. It is likely that such power will have to be sent by long-distance transmission, either to large Canadian electro-chemical industries (such as the manufacture of aluminium, carbide or the ferro-alloys), or to the denser centres of population in New York State.

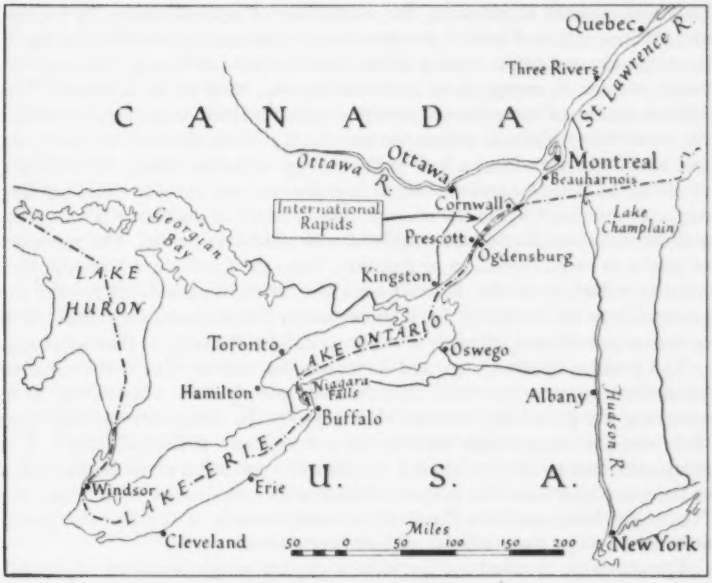


Fig. 6. The St. Lawrence Deep Waterway and Power Project

At the downstream end of the International Rapids Section of the St. Lawrence, there is already the Beauharnois Power House of the Quebec Hydro-Electric Commission, 22 miles west of Montreal. Development continues; by 1953 the installed capacity of Beauharnois will be substantially more than 1,000,000 kW. and it will in due course become the largest single power plant in the world, with a capacity half as much again as in 1953. To achieve this, 210,000,000 cubic yards of material will have been excavated in building a canal, 15¼ miles long, 3300 feet wide and 30 feet deep, to bring the water to the turbines.

Farther upstream, the St. Lawrence river system (of which the Niagara river is a part) has again made possible, on an international frontier, one of the most important centres of electric power production in existence. Between Lake Erie and Lake Ontario the river drops 326 feet, with an average flow of

210,000 cubic feet of water per second. By the Boundary Waters Treaty of 1909–10, between Great Britain and the United States, the amount of water that could be diverted from the Falls for the generation of power was fixed at 56,000 cubic feet per second; this was primarily in order that the scenic qualities of the Falls should not be destroyed. During the Second World War, however, Canada cooperated with the United States in building a submerged weir above the Falls, which maintained their scenic grandeur whilst enabling more water to be piped from behind the weir to the great power stations downstream.

In the newer countries of the world, where political frontiers tend to have little geographical significance, the availability of natural sources of energy, and the generation of power, are matters of paramount moment to economic development and to the raising of the local standard of living. The conventional sources of energy, coal and water-power, tend to be scattered. The African continent more than any other continental land-mass, except perhaps the Australian mainland, suffers not only from a severe shortage of water over vast areas, but also from a lack of the energy of falling water. The Congo, the Nile, the Zambesi and the Niger, in that order, are the only rivers offering major resources of hydraulic energy. The location of coalfields is scattered, and the transport of coal always difficult and often impossible. The transport of power as such, regardless of frontiers, from the fixed sources of supply—mine or waterfall—to the distant points of consumption, appears to offer the greatest hope of a solution, for a transmission line is a static structure, with no moving parts, and infinitely cheaper to build and maintain than a railway.

The position of the Congo and its tributaries, and the fact that their total hydraulic resources are still unmeasured, prompt the supposition that, assuming the possibility of transmitting power by direct current over long distances, the Congo might become the power house of Central Africa. It is significant that territories beyond a radius of 1500 miles come within reach of the great hydro-electric projects already under discussion on the Nile, the Niger, the Volta and the Zambesi, or within reach of the thermal power stations based on the coalfields of Southern Africa.

Transmission by overhead line across tropical jungle is not an impossible achievement. Leopoldville, capital city of the Belgian Congo, is, for example, supplied with electricity from the Falls of Sanga, 100 miles away in the dense forests of the Belgian Congo. Nearby, the Inkisi river plunges over a twisted rock ledge, some 60 metres high, at Zongo Matanda. Swiss and Belgian engineers are at this moment harnessing the Fall, to supplement the supply of electricity to Leopoldville. The luxuriant vegetation on rivers such as these may remind the sightseer that man has not yet contrived to harness the energy of sunlight with any measure of success. The controlled growth of plants and trees in equatorial regions, and the growth of coniferous trees in northern latitudes, involving in both cases photosynthesis as a means of harnessing the energy of sunlight, may yet prove to be the greatest source of unharnessed energy in the world, other than nuclear energy, whether as fuel or for the distillation of alcohol.

In the Union of South Africa, future supplies of power are already imperilled by another difficulty which is geophysical in origin. For practical

purposes the inland power stations, all of which involve the use of the thermal cycle in their operation, are dependent for cooling water on the Vaal and the Orange rivers. A point will be reached within the next ten years when there is no longer sufficient water in the Vaal to support further power stations, in addition to the demand of existing power stations and of the other users to whom the water is being supplied. There lie open four possible alternatives. The first is the installation of additional thermal stations on the coast, cooled by sea-water, and the transmission of their energy inland probably as direct current. The second is the development of power stations that do not need cooling water—the gas turbine is still in its infancy but it is noteworthy that, for similar reasons, the first gas turbine power station in Africa is now being built near Nairobi. The third is the possibility of direct current transmission over a distance of 800 miles from the proposed new hydro-electric station at Kariba Gorge on the Zambesi, which—if built—may well be the largest in the world other than Beauharnois on the St. Lawrence. Yet another solution is the somewhat restricted one adopted at the new Orlando generating station near Johannesburg. This plant has been sited near an artificial lake, kept replenished by the clear effluent of the City's sewage disposal works; thereby establishing the somewhat curious inter-relationship that there can be no power without sewage—in a modern disposal works the converse is already true.

The greater part of this paper has been devoted to a survey of the problems associated with the generation of electricity from fixed sources of energy, and its transmission from the point of production to the place of consumption. The claims of other sources of energy cannot be overlooked. Of the transportable sources, oil is the most easily moved from place to place, whether by tanker or pipe-line. The Leduc and Turner Valley oilfields in Alberta owe their importance not only to the fact that they may well prove to be amongst the world's richest, but also to their being within reach of the Great Lakes—St. Lawrence Deep Waterway now to be built; itself a project brought within the bounds of economic possibility because it may keep a 2,000,000 kW. hydro-electric plant in operation. A similar combination of long-distance transmission by pipe-line and then by ocean-going tanker is to be seen in the oil-bearing regions of the Middle East. In fact, as well as in a metaphorical sense, it is the "geography of power" that is now conditioning the economic development of the Middle East.

As an alternative source of power, the energy of the wind may prove to be one of the most important. Figure 7 shows one of several systems designed to generate blocks of power of reasonable size from the wind (the power generated by the traditional wind-mill of the lowlands is negligible). In this system the generator is mounted at ground level and is coupled direct to an air-turbine, which in its turn is driven by the updraught of air drawn through the hollow tower and propeller blades by the centrifugal force occasioned in the blades as the wind turns them. The generator is in fact turned by a stream of air which is secondary to the wind itself. The system is being developed experimentally in France and in Britain. A prototype machine is now being built for the British Electricity Authority with a capacity of 100 kW. It will be complete and ready for erection in 1952. Its ultimate

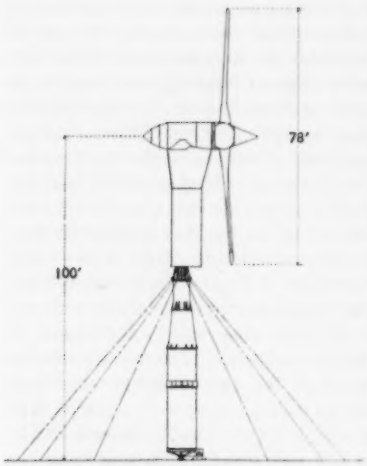


Fig. 7. The "Depression" type wind-driven generator (100 kW.)

destination is a hill top near Aberdaron in West Wales, where the contours give a boost to the wind. It will be connected up to feed energy in parallel into the existing grid. It may well be that the economic size for these machines is substantially larger than 100 kW. There are many areas in the world where such plants might be installed; an output of 4000 hours per kilowatt per annum is thought to be the minimum necessity for economic working in Great Britain. In countries where fuel is more costly, much less than 4000 hours would be an economic proposition.

Tidal power may also be of great importance where there is a large tidal range and storage facilities. France is a case in point. Studies for an experimental scheme on the Rance Estuary in Brittany are already well advanced, and the Mont St. Michel scheme is also likely to be undertaken sooner or later (Fig. 8). The tidal range at Mont St. Michel is 11·8 to 41·3 feet and the area to be enclosed by the two dams 140,000 acres. The calculated output is given as 25,000,000,000 kWh. per annum, from plant with an installed capacity of 3,000,000 kW. The ratio of the length of the dam to the area enclosed, and to the energy to be produced, are both extremely low. The scheme may be of some importance to Britain, in as much as the development is regarded as being complementary to the connection of France to Britain by cable. For other reasons the cable project may well be completed before the tidal scheme is built.

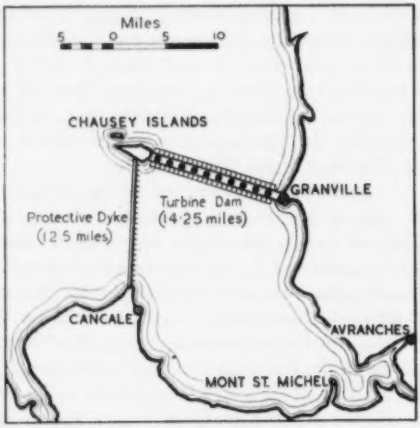


Fig. 8. Projected tidal-power scheme at Baie de Mont St. Michel

Another source of energy being explored by French engineers is the possibility that in tropical areas the difference in temperature between water at the sea surface and at great depths may be exploited. Experiments are

now in hand in France with a view to the installation of two 3500 kW. plants at Abidjan on the Ivory Coast. "Le Trou sans Fond," $2\frac{1}{2}$ miles from the coast, has a depth of 1300 feet, and a temperature differential between the surface water and the bottom of 36° F. With a high vacuum in the turbine-housing and evaporator, warm water from the surface will boil on admission, the steam passing through the turbine; on reaching the low-pressure side of the wheel it meets a spray of cold water which condenses it and thereby increases the pressure difference. The turbine wheel is designed to have a diameter of 26 feet, and to run at 600 r.p.m. The French are tackling this project with great earnestness and the difficulties of installing the deep inlet pipe for cold water have already been studied in prototype, off the coast at Brest.

The internal heat of the earth, in volcanic regions, is another source of energy which by its nature is fixed in position and only transportable in the form of electric energy. At Larderello, in Tuscany, energy had been generated in this way since 1914 until the plant was totally destroyed by the Germans in 1943. It is now being reconstructed with an installed capacity of 114,000 kW.; and with a projected capacity of nearly half as much again. The temperature is constant at each well, but varies from well to well between 285° and 420° F. The output is so constant that these stations are regarded as base-load stations, to be operated in conjunction with high-head hydro stations, whose output can be varied.

In New Zealand, the possibility of harnessing the subterranean steam in the thermal region of Wairakei is also being actively investigated. Fourteen bores have been sunk to depths between 500 and 1000 feet. The steam is wet and the authorities have decided to bore down to 2000 feet in search of dry steam. One well, with a 4-inch bore, is already giving 120,000 lb. of steam per hour from a depth of 575 feet, the equivalent of 50,000,000 B.Th.U. per hour; the steam is 28 per cent. dry. The drillings are undertaken within the thermal regions, but not where the more spectacular thermal phenomena are visible on the surface.

The place of nuclear energy in relation to world resources of power for use at a controlled rate of output is still indefinite. It is still uncertain whether nuclear energy must first be transformed into heat energy, with low efficiency, before it can be harnessed, or whether the production of electrical energy direct from nuclear energy will be possible. In either case, if the economics of the process are favourable, the transport of the reactive material is likely to be a minor operation in relation to the cost of the fixed plant required.

So must end a swift and superficial survey of possibilities. The sources of energy in the world of today, and therefore of power, are situated at points on the earth's surface which, in the main, are unrelated to the points where that energy must be used. As consumable sources of energy become scarcer, or less accessible, so must greater use be made of those which cannot be exhausted, such as falling water, flowing water, tides, winds, geothermal heat and others.

Many of the great consuming points of the world came into being in their present location—Rio de Janeiro and Sydney are examples—for geographical, historical and commercial reasons which bore no relation to the ultimate

requirements of power. In the hinterland of Rio, in the Australian "outback," or across a strip of water such as separates Denmark from Sweden, or Sweden from Gotland, or Wellington from the South Island of New Zealand, or even Tasmania from Australia, there lie great undeveloped resources of inexhaustible power. It is right that man should explore the possibility of harnessing such potential and of bringing it to the point where it is wanted. The geography of power is at last becoming a part of the economic geography of our times, and of the future.

Lord Verulam's paper was followed by contributions from Mr. J. Houston Angus and Mr. S. Chaplin

Mr. Angus said:

It has been part of my task over the past several years to make assessments of the particular needs of three very different countries in three different continents—Germany in Europe, Bolivia in South America and Nigeria in Africa. A further task has been a general assessment of the needs of most of the countries of continental Europe, including many of those behind and astride the "Iron Curtain," with a view, through the machinery of the United Nations, to coordinating their planning.

Let us examine the case of Nigeria, Britain's largest protectorate, a country of perhaps thirty million inhabitants, roughly 600 miles square (far larger than the United Kingdom), which has a consumption of between 2 and 3 units of electricity per head per annum, compared with a consumption in the United Kingdom of around 1000 units. Nigeria has a tremendous agricultural potential which could be increased by a proper irrigation system, which would itself depend on electric pumping. It is an important source of the strategic metal, tin; it is believed to be rich in other metals such as zinc, lead and columbite. There is some evidence that oil may be found, and active measures are in hand to prove the possibilities. The country is awakening politically, the people are demanding a higher standard of living, and for each and every one of these purposes a fundamental need is electricity. The Government of Nigeria, recognizing the need, recently set up an Electricity Corporation to plan and implement this development, and work has started. The first objective is to provide adequate power in those centres where industrial mining development is projected. The resources available are the hard coal that is already being extracted at Enugu, the lignite, potentially important but so far unproven, near Asaba, and water power—on the Niger river at Jebba, at Shiroro on the Kaduna river, on the Ogun river north of Lagos, and at Ewa Falls north of Calabar. Unfortunately, the information available on the hydrographic conditions is negligible, on the meteorological conditions sketchy and on other factors, such as run-off, non-existent. There is believed to be well over a million kilowatts of capacity available at Jebba alone, while the immense potential of the Cameroon Highlands has not hitherto been recognized. It is even said that there is a waterfall that is second only to the Victoria Falls, but so far that is the only information available. The Corporation is actively engaged in organizing survey parties, setting up gauging stations and collecting data in order to lay the foundations of a future assessment of the useful potential.

In the meantime reliance must be placed on the thermal resources available, and that means the exploitation of the coal resources at Enugu. The principal and immediate potential markets for electricity lie west, east and south of Enugu, and it therefore forms a strategic centre from which to develop the power potential. This could of course be done by transporting the coal to the centres of consumption, actual and potential, but as the transport system is inadequate and costly the transmission of energy is likely to be cheaper; it is also more flexible and provides a better opportunity to develop other economic activities in intervening areas. Planning for a major coal-burning station in the neighbourhood of the mines is in progress, while the proposed transmission system has already been the subject of detailed technical analysis.

Briefly, the proposals are initially to build up a network radiating from Lagos at 132 and 33 kV., stretching far to the north and east of Ibadan; the network will eventually be fed from Enugu through a 220-kV. transmission line to Ibadan, which will ultimately have to be duplicated and extended to Lagos. On the completion of the first coal-fired station near Enugu, 132 kV. lines will radiate to Abakaliki and to Port Harcourt, while a subsidiary network connecting Benin, Sapele and Warri is under consideration. Lightning will be one of our principal operating problems, while the nature of the land around Lagos, and in the coastal areas generally, constitutes a major constructional difficulty; building transmission lines in swampy ground will not be an easy task.

This short survey of the practical relation between power planning and geographical considerations may serve to illustrate why we power engineers are anxious and honoured to be members of this Society.

Mr. Chaplin said:

It was for Sweden a life or death matter that she should get power from her Arctic provinces. For France the task of harnessing the Rhône and building twenty power stations and twenty dams across it has involved the country in a gigantic outlay in money and material. Génissiat, the greatest of these, and probably the finest above-ground station in Europe, has caught the imagination of the French people and has become a National shrine. Britain has no Arctic provinces and no Rhône, but such schemes could be repeated again and again in countries for whose well-being we are directly responsible and from whose well-being we have everything to gain.

At home there is the battle for efficiency in our power stations. Success with the development of the fuel cell would be a triumph equal to the building of ten Génissiats. A power cable across the English Channel would ease the burden of our peak load and make us a partner in the power geography of Europe. If these were brought to fruition together, and in about ten years from now, Britain would find herself a major power exporting country with the immense prestige and economic advantage which accrue to any country with kilowatts to spare.

DISCUSSION

Evening Meeting, 17 December 1951

The PRESIDENT said: To-night we have a subject which is of great interest from several points of view. We are going to have a discussion on 'the geography of power' which will be opened by the Rt. Hon. The Earl of Verulam, who will deal with the world-wide growth in the demand for electric power and the problems it raises; he will suggest measures for reducing the effects of physical and political barriers to transmission, and for harnessing new sources of energy. There will also be a transmission by radio-telephone from Sweden. Lord Verulam's paper will be followed by a contribution from Mr. J. Houston Angus, Chairman of the Nigerian Electricity Board. Mr. Angus was to have spoken to us over the radio-telephone but, fortunately, he has arrived from Nigeria in time to speak to us in person. He will be followed by Mr. Stephen Chaplin, of Enfield Cables Limited, who will also show a film illustrating the laying in 1951 of a 132,000-volt submarine cable for the transmission of power between Sweden and Denmark.

Lord Verulam then read his paper

The PRESIDENT: We have to thank Lord Verulam and his two collaborators for the original and very practical way in which they have presented this subject. I now call on Mr. Marshall of the British Electricity Authority to say a few words.

Mr. C. W. MARSHALL, Deputy Chief Engineer (Research), British Electricity Authority: Anything that I have to say can come only as an anti-climax to what you have already heard, but I think it may be of some interest to mention a point or two. Events have shown the great importance of hydraulic electric schemes. I am reminded of the early achievements of Kelvin, who always advocated the use of direct current because of its enormous success in telegraphy across the ocean. It has always puzzled me as to why it should have been considered worthwhile to lay thousands of miles of cable for the purpose of communication and yet to have given so little consideration to cable laying for the transmission of electrical supply. I understand, by the way, that Canadian engineers are now preparing to construct a 30-mile high-voltage cable, to be laid in the bed of St. Lawrence.

My second point is the utilization of wind power, on which Lord Verulam has touched. In this country, hydro-electric power is equal to perhaps only 5 per cent. of thermo-electric power; it is not unreasonable for us to expect to get an equal amount of power from the wind. Experiments are being conducted by people expert in aerodynamics which may result in a machine of 100 kilowatts capacity which will demonstrate the possibilities of wind power.

Sir ERIC RIDEAL, Professor of Physical Chemistry, King's College, London: It has occurred to me very often, as I suppose it has occurred to all of us, how nice it would be if all motor cars were electrically driven, and when the accumulators ran down we could put in some more power and run on again. But, of course, it may be not so economical as would at first sight appear. Your battery is working, you are burning zinc and so on. Attention is now being fixed on alternative methods of using carbon from coal to get electric power It is rather important to think about it because present methods are limited in thermodynamic efficiency.

The PRESIDENT: We end by thanking the various speakers and others who have honoured us by their presence here to-night. I would invite your attention to the exhibits illustrating this evening's paper in the adjoining room.

THE BAFFIN ISLAND EXPEDITION, 1950

P. D. BAIRD

I VENTURE TO begin my paper with a considerable digression on the general subject of exploration in Arctic Canada, and on the problems of expeditionary planning.

I believe that this Society last heard of Canadian Arctic exploration in January 1951, when Peter Scott described his expedition to the mouth of the Perry River, and before that it was as far back as the summer of 1948 that Dr. T. T. Paterson spoke on Arctic Canada, at the meeting at which medals were presented to Dr. Camsell, Inspector Larsen and Mr. Manning. Mr. Manning, who was then awarded the Patron's Medal, is now Chairman of the Board of Governors of the Arctic Institute of North America. The Institute, of which I am a staff member, is very youthful in comparison with the Scott Polar Research Institute at Cambridge and even more youthful when compared with this Society. But in its brief existence since the end of the last war it has, I believe, done a good deal to stimulate Arctic research in the general area of North America. Mr. Scott's expedition was in fact supported in part by the Arctic Institute, and so was the last Arctic project carried out by Dr. Paterson.

Apart from the foundation of our Institute, which filled a long-felt gap in the organization of North American Arctic research, there have been a good many changes in these recent post-war years which have quite altered the picture, and the methods of investigation, in northern Canada. We have here the largest territory within the true Arctic regions, since the area north of the tree-line in Canada exceeds even that in the Soviet Union, which in its turn is slightly larger than the whole of Greenland. Yet we have less scientific knowledge of Canada than of any other of the Arctic lands. We do however now know the full extent of Canadian Arctic territory, for in the last few years a tremendous programme of aerial photography has been carried out by the Royal Canadian Air Force; and, as a result, maps on the basic scale of 8 miles to the inch, are now being compiled and are being published with considerable regularity. This has made a very great difference to the planning of expeditions, for it is now possible to examine in the photographic library the entire area which an expedition wishes to cover. It has also reduced the need for most reconnaissance topographical survey on expeditions, except perhaps for the detailed survey of some very small area and the need for establishing heights. Another big change of recent years is the advance of settlement into the northern islands. Prior to 1947 only one Mounted Police station existed there (or at most two); now five weather stations are located in the northern rank of islands, frequently and luxuriously supplied by air, with the main heavy equipment coming in to the central station at Resolute Bay by sea each summer in ships of the United States Navy. These northern weather stations are operated jointly by the United States and Canada, with Canadian officers in charge. Another change of interest in the last few years

is the re-determination of the North Magnetic Pole, of which we had rather lost track since Amundsen's determinations of 1904–5. It was known that it had moved considerably, both from the mathematical researches of the Astronomer Royal and from the direct observational findings of long-distance aircraft which began ranging over the far Canadian Arctic in 1946. Several expeditions carried out by the Dominion Observatory in Ottawa have now succeeded in establishing its position in Prince of Wales Island; permanent magnetic stations have been occupied and considerable readjustments have been made in the magnetic charts of the region.

In some other fields a growing awareness of the importance of the Canadian north has been shown by our Government. The Fisheries Research Board is sponsoring marine expeditions, organized and led by Dr. Dunbar, in Hudson Strait, Frobisher Bay and, according to their future plans, in Hudson Bay itself. It seems that the warm waters which have so changed the economic picture in south-west Greenland are beginning to spill into this area of the Canadian Arctic also. The Geological Survey of Canada has also taken several large strides farther north, to Baffin Island and Cornwallis Island, and in the summer of 1952 a very large group will be operating by helicopter in the area between the west coast of Hudson Bay and Great Slave Lake, a method which the United States Geological Survey has been finding useful, and surprisingly economical, in Alaska. In this last area, one of the largest North American mining companies is beginning what may prove to be an important development, the first such venture on any scale north of the tree-line. In sub-arctic areas of Canada major mining developments are becoming more and more important, and the Labrador iron ore and the Yellowknife gold mining areas form important stepping stones for work farther north. We now have an all-weather road to Great Slave Lake and may soon even have a railway.

Canada is therefore entering on a period of great activity with limitless opportunities; yet there is at present one limiting factor on which we have to bring all our energies to bear, and this is the factor of Canadian personnel. I am not at all sure that the size of Canada and its great northward extension is not more appreciated south of the border than it is in our own country, where too often we think of Canada as a strip of land of great length but of no great depth, with the United States border always near at hand. One can be too close to a territory to be able to focus well on it. The man or youth of adventurous spirit in Canada has plenty of wilderness country close to the established fringe of civilization from which to choose; the traveller from the United States or Britain, when suffering from a similar urge, is liable to go much farther into real northern territory.

It has been found quite difficult to engage the right type of personnel for the northern weather stations, and the applications which we receive in the Arctic Institute for northern work by Canadians continue to be disappointingly few. We are continuing to welcome more enthusiasts from this country, but we have also much to do in Canada itself to get the work accomplished. In Canada we have rather a delicate situation, with a great power in a rather expansive mood to the south which will step into the vacuum if we do not fill it.

I have spoken of some of the excellent work which is being performed by branches of the Canadian Government and of the valuable advanced bases for exploration which have recently grown up. But there has been to date a remarkably small effort by Canadians not connected with the Government. Let us take the scientific exploration of Baffin Island as an example. There have been the Government sponsored expeditions of Bernier in the north; the very excellent work done by Soper and Burwash, both Government officers, in the expansive pre-depression age, and recent Geological Survey activity in the south. But the only private Canadian expedition I can think of prior to 1950 was the Bernier Expedition of 1912, which was looking for gold. On the other hand the private expeditions from other countries add up to an impressive list; expeditions such as the great Danish Fifth Thule Expedition, and those of the Germans, Boas and Hantzsch, the British, Wordie and Manning (twice each) and the Americans, Putnam and McMillan. I am convinced that there is a very real part to be played by private scientific expeditions whose aims should be the most basic research, for they will not have its utility questioned by members of Parliament going over the estimates. Dr. Bertram has written some pertinent comments in the *Polar Record* about the stimulating part played by expeditions of young men from this country. But the planning of a private expedition, often not very well backed financially, has to be a painstaking task of great attention to detail.

Before the days of the aircraft, scientists, and particularly biologists, were forced to spend a whole year in the Arctic in order to be on the ground early enough in the spring and summer. There was little they could do in winter except survey work and to lay out caches. With the rapid progress made by aerial photographic mapping, reconnaissance topographical survey is usually valueless. Now there must be some special reasons for a wintering party: it may be the need to collect a year's meteorological records, the testing of cold weather equipment or physiological processes, or anthropological investigations which involve living and moving with the native peoples in what is the longest and most important season to them.

The middle of May is none too early for a zoologist to be in the field; two weeks later the botanist can get going on the tundra; those studying glaciers wish to have a complete ablation season and again early June is high time to be at work. And yet it is not until six to eight weeks later that sea transport is able to reach much of the true Arctic. An aircraft is the solution to the difficulty and, if one is flying in to the area, why not retain the use of the plane for transportation around it? It usually calls for a large-sized party, unless some particularly lucky financial situation exists, to justify the expense of an aircraft, even if it is only a chartered flight to and from a single work area. I would say it takes at least a dozen people to warrant the use of an aircraft which, even with a limited amount of flying in the area, will cost several thousand pounds.

A dozen or more people take a little choosing and handling, and it is perhaps not impertinent to indicate here some of my personal ideas on the qualifications for an Arctic expeditionary member. Interest and keenness come first, I think, and here one should test if the interest is genuinely deep or merely curiosity. One good test is to find out if a man has read Arctic

history at all deeply. Another important thing is a man's willingness to go without sleep or with very little. Then there is the necessary knowledge of camping technique, and especially the ability at least to get by on ski, to handle a boat or canoe and outboard motor, and to walk far and carry loads. Only one or two exceptions, known and acknowledged beforehand, should be tolerated.

My own experience is that one can be most sure of those who have been mountain climbers. The kind of initiative that impels one to climb mountains is just the curious kind that is needed on an Arctic expedition, and one can be certain that such a man is able to walk fast and carry loads over the very rough terrain that the Arctic can provide even on the flat. A keen skier is by no means a certain bet. In North America one can be a good and even an adept performer without ever leaving the tow hills. Arctic ski-ing requires the *langlauf* type, carrying loads or pulling sledges over the flat or uphill—an unloaded downhill run on ski is rare.

In choosing a man I would rate his qualifications for the scientific work at 40 per cent., his experience and capability of living hard and having the qualities set out above at 30 per cent. and his personality and good humour at another 30 per cent. The leading scientist in the world in some field who does not rate well in the other two categories would be a menace of the first order on an Arctic expedition (and sometimes has been).

Included in the party should be someone with a knowledge of radio and engineering and a specialist in photography; we had these in Baffin Island, but not an instrument repair specialist (which one can scarcely hope to include) who would have been useful to repair the ever-increasing number of watches and meteorological instruments which fell by the wayside. Everyone should be a good "fixer" though, able to sew up tents, repair stoves and create useful devices, without necessarily being a trained engineer.

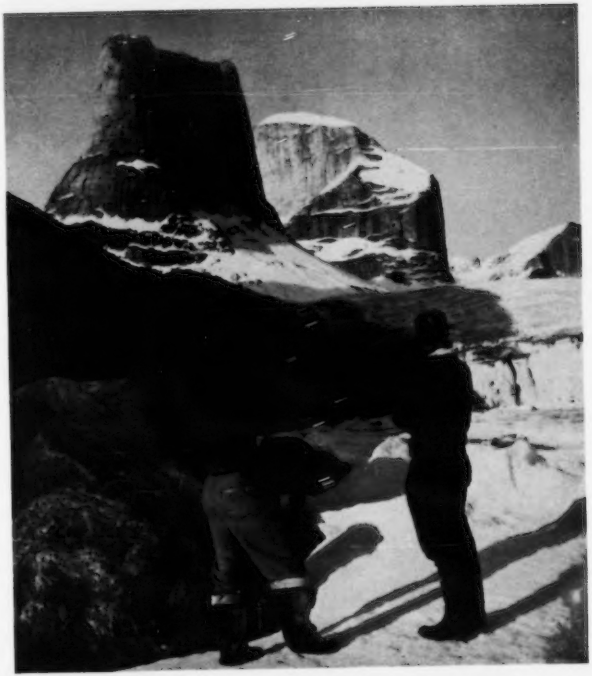
The Expedition

The personnel of the 1950 expedition did not perhaps come up to all these qualifications in full measure, but many of them did extremely well, and we had a very happy and hard-working team. It was, by accident more than design, quite international in character. Four of the members, including our pilot and our photographer, were from the United States, three were from Great Britain, and three from Switzerland. The remainder were residents of Canada, but some of these had come originally from other countries: from Finland and Norway, and myself from Scotland. Four of the Canadian personnel were students at McGill University; two were women. All the senior people had had previous Arctic experience; Dr. Wynne-Edwards had been in Baffin Island as well as in the western Canadian Arctic, Dr. Dansereau had been in the Hudson Strait area, Dr. Goldthwait in Alaska, Dr. Kranck in Greenland and Labrador, and Mr. Ward in Jan Mayen Island.

The scientific purposes of the expedition were threefold; there was first a biological programme in which studies of the zoology, botany and ecological relationships were to be carried out in one main locality throughout the summer. In the geological field a reconnaissance map, particularly of the fjord coasts, was to be made of as large an area as time permitted, and specialized

Sam Ford Fjord from near the summit of Broad Peak

The R.C.A.F. Dakota used by the expedition



Broad Peak (5960 feet) in the centre background, from the fjord

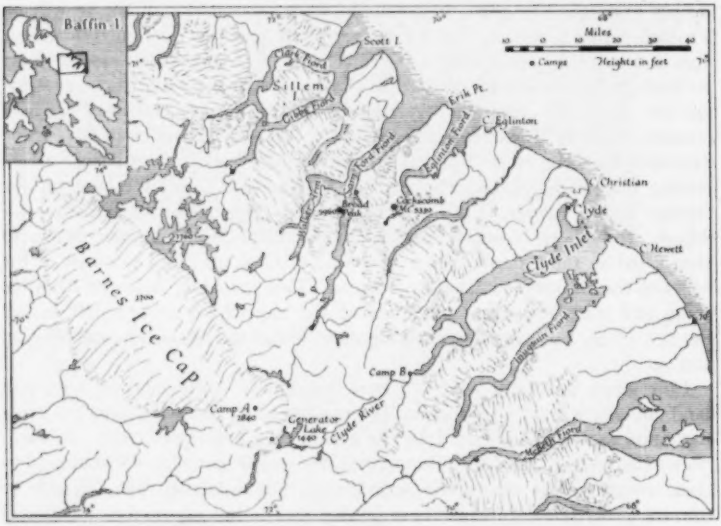
studies in petrology and in geomorphology were to be carried out. In the glaciological field particular attention was to be paid to the Barnes Ice Cap, the limits of which (after several years of uncertainty) we now knew from a study of aerial photographs, and which seems unique in that it is not resting on high ground but is completely surrounded by bare ground of no great elevation.

The expedition left Montreal in May 1950, but long before that a good deal of work had been accomplished. In the previous August much of our stores had been shipped by sea to the little settlement at Clyde, which is a Hudson's Bay Company trading post and a weather station of the Canadian Government. Most of the members of the expedition were flown to Clyde in a Dakota aircraft of the Royal Canadian Air Force, a service for which we are deeply grateful. The plane which took us on the final leg of the trip, from Frobisher Bay to Clyde, was a rescue aircraft normally stationed at Goose Bay and specially fitted with a ski-wheel undercarriage which made it easy to land on the smooth ice of the bay at Clyde, at this time of the year some six feet thick and scarcely covered with snow. For use during the whole summer Colonel Wood, my colleague in the New York office of the Arctic Institute, had lent us the Norseman aircraft which had been working for him during the preceding two summers in the Seward Glacier region on the Alaska–Yukon border. This aircraft also was fitted with combination ski-wheels, the wheels being retractable by several inches, a similar device to that fitted to the aircraft which was sent to Graham Land to assist in the relief of the Stonington Island personnel. This machine, flown by Maurice King and with two other members of the expedition aboard, left before the rest of us, but we all reached Clyde at about the same time on May 19 and 20.

Conditions were still wintry. There was almost uniform snow cover on land and sea, except where it had been removed by the wind, but the midnight sun was up and it would only be a short time before this cover vanished. So we had to work energetically to get all the people and stores distributed to their working areas during the period when the Norseman was still able to operate on its ski-wheels. In these few weeks I found my mathematical skill considerably taxed in working out payloads for the machine for flights of varying distances and trying to achieve some kind of economy in our fuel consumption. Very soon our stores were sorted and we were able to make the first flight inland. It was planned to establish the main camp on the ice-cap some 100 miles from Clyde, but lowering clouds forced us to turn back; so we landed and established Camp B, the biological base at the head of Clyde Inlet. Here we were lucky in discovering a ready made airstrip on which the plane was able to operate on wheels. After a little work with shovels, 2000 feet of dry beach was prepared and Maurice King erected a home-made airfield wind sock which I know was still standing some ten months later. Four days later we were able to reach the ice-cap and set up Camp A on what we believed to be the highest point of the south-eastern lobe; it turned out later that this was at 2840 feet and the main part of the ice-cap rose some 900 feet higher, 30 miles to the north-west, but it was a suitable area for our work, and by June 1 we had begun regular meteorological observations which

continued for nearly ninety days. During all this time Svenn Orvig, the meteorologist, only saw the dry land at a distance.

Two other parties were next established in the field, the Swiss mountaineering group at a camp on Sam Ford Fjord in the middle of the spectacular coastal mountain range, and the geological party on Gibbs Fjord farther to the north. To the first of these camps we also sent a native dog-team with a canoe to be left farther up the fjord for use by the geologists as soon as the ice went out. The Eskimo are not very numerous in this area and, working chiefly inland, we had very little contact with this splendid group of people. We saw more of them at Clyde settlement, particularly at "ship time." The geologists were originally equipped with a small man-drawn toboggan with



which they made their way from the mouth to the head of Gibbs Fjord. By June 4 we had moved, in all, some 10 tons of equipment in a total of thirty-five flying hours, and for another twenty days it was still possible to use the aircraft on skis and make some reconnaissance and further supply flights. One of these flights was a more extended one over the Barnes Ice Cap itself. It was planned to last for only a few hours but, due to sticky snow conditions on one of the lakes on which we landed, and subsequent bad weather, it took two days. We laid down a cache at the north end of the ice cap with a view to making a lengthy gravimetric traverse as far as this, but found later that we could do better by confining our traverse to the south-eastern lobe. Other caches of food and fuel were established at different points for the mobile geologists to pick up as they progressed during the summer; we hoped that none of them would be visited by polar bears.

On June 24 the plane left to return to Frobisher Bay airfield, 400 miles

away, to change its undercarriage to floats for use on the open water that would prevail in July and August. It was away until July 17, during which time we could only move on foot. There was actually sufficient open water at Camp B some ten days before this, but there was still too much ice at Frobisher Bay to allow a take-off. The floodwater from the land at Camp B was in fact very great during the last week in June, almost preventing movement; we needed more folding boats. During this period, Hans Röthlisberger and I walked down from the ice cap to Camp B, examining the Clyde River valley on the way.

The first task for the plane on its return was to visit the geologists, Kranck, Riley and Eade, who had been the only party left without a radio during this break-up season. The intention had been for the two younger men to walk from Gibbs Fjord to Walker Arm and start work with their canoe; an accident to Eade, in which he fractured a small bone in the foot, prevented this and they were still at the head of Gibbs Fjord which, annoyingly enough, was the last fjord head to lose its ice cover; we were not able to land on floats there until July 24. We had however dropped them some more food knowing that they were running low, and here I made the cardinal error of including a 4-lb. tin of strawberry jam in a free drop from a plane travelling at 90 miles an hour.

Having moved the geologists, who then continued their work by canoe in Sam Ford Fjord and later in McBeth Fjord and Clyde Inlet, we next moved the mountaineering party across to the head of Eglinton Fjord which, as you may recall from the account of Mr. Wordie's expedition in 1934, is a very spectacular area. This group climbed some seventeen major peaks including Broad Peak which rises to just short of 6000 feet directly out of Sam Ford Fjord, and the Cockscomb (5330 feet) which was the most difficult rock ascent they accomplished. All three of the Swiss climbers were geologists and examined the geology of the region in considerable detail. An account of their part of the expedition has been published in that beautifully illustrated publication, *Berge der Welt*.

In August, after re-stocking some of the camps, two longer flights were made, one to the west coast of Baffin Island and the other to the south-east to Padloping Island. On the first of these we got a view of the extensive peneplain area to the west of the ice cap and landed on one of the flat limestone islands, Bray Island, off the west coast. On the second flight the biological group visited Cape Searle where there is one of the largest fulmar petrel colonies in the world, a colour photograph of which has been published in the *Geographical Magazine*.

Before the end of August we experienced a rather early onset of winter. Snow lay on the mountains down to about 1000 feet and the ice cap, which at the end of July had been running with water in many deeply incised streams, became once more the uniform white snow-covered expanse it had been when we first reached it. The expedition was due to leave on the Canadian Government supply ship *C. D. Howe* and, as she was rapidly approaching Clyde, we had a busy time evacuating the camps and withdrawing everyone to the base.

On September 4 the ship arrived, and sailed the next day with fourteen

members of the expedition aboard. One man, our photographer, had already left for the south from Padloping and the remainder of us now flew down in the Norseman to Frobisher Bay and thence to Montreal, a flight not without incident for we holed one of the floats at Frobisher Bay and had to make temporary repairs both there and at Fort Chimo where we next landed.

It will be some time yet before the full scientific results of the expedition are published, but some have already appeared, and it is possible for me to give a brief résumé. Dr. Dansereau made botanical collections and studied the ecology; primarily of the area around the head of Clyde Inlet which, as it turned out, was rather peculiar as both its flora and fauna were richer than we had expected for this latitude in Baffin Island. It seemed that, protected perhaps by a great S-bend in the fjord and with several square miles of country not much above sea-level, there is here a kind of oasis where the climate is more favourable in the brief summer than it is on the coast where the cold Canadian Current makes life much harsher. Such plants as *Salix cordifolia* and *Dryopteris fragrans* were found here. One of Dr. Dansereau's projects, in which he was assisted by Margaret Montgomery, was a study throughout the season of the soil and root temperatures of various plant assemblies. The results have not yet been worked out, but I do know that they were extremely energetic with their thermometers for they managed to break about thirty during the season. Mason Hale, the assistant botanist, was a specialist in lichens and he found much of interest in this rather neglected field. Several species new to the eastern Canadian Arctic were discovered, and far more species were found at Camp B than had been recorded before in all Baffin Island; he also worked for a short time around the edge of the ice cap where his knowledge of the growth rates of certain lichens assisted us to determine at least the minimum time during which some of the areas had been ice free.

Dr. Wynne-Edwards covered a great many fields of zoological study, making extensive collections of insects and the freshwater fauna. His chief work was however on the birds of the region, and he found that at Camp B all six of the small passerine birds now known to breed on Baffin Island were locally plentiful. A gyrfalcon's nest near the camp provided an interesting study throughout the summer. Ducks and geese were very infrequent on the east coast but breed in large numbers on the west. In late July and August there was an interesting migration of King Eiders, almost all drakes, which crossed from west to east over the southern edge of the ice-cap, flying so low over the lakes and rivers that on occasion they knocked down a lake level marker we had erected and flew both over and under a ferry rope. Dr. Wynne-Edwards believes that this migration probably continues directly across Baffin Bay to West Greenland. He paid particular attention to the interbreeding or otherwise of the races of horned larks and redpolls and also observed the breeding biology of the small birds which were here frequently re-using old nests, and thus saving valuable time in the short breeding season. During a brief visit to the fulmar colony at Cape Searle he estimated that the number of birds present was of the order of 200,000 and made observations on the properties of light, intermediate and dark forms.

The geology of the district was examined as far as circumstances permitted,

with the rather usual result that it was only towards the end of our season that we had a sufficiently good general picture to know which areas should be investigated in greater detail. It was possible to distinguish an eastern seaboard zone and a western inland zone in the Archaean rocks. In the former group gneisses formed the bulk of the rock, and there was a complete absence of any intrusions of true granite. The inland zone between the heads of the deeper fjords and the ice cap was characterized by some ancient altered sedimentary rocks including a very beautiful marble formation, white and rose coloured, underlain by quartzite. Near the ice cap there was exposed an interesting iron formation of banded chert and magnetite, very upsetting to the compass, and between here and McBeth Fjord there was a great showing of gossan and sulphide-rich schists. There are many pegmatite dykes throughout the area, some with an apparent high content of fluorine minerals and with some columbite. The largest dyke near the iron formation at the ice-cap showed some enormous crystals of black tourmaline. From our reconnaissance it would seem desirable to investigate more closely the area between McBeth Fjord and the centre of the island.

Dr. Goldthwait divided his time between geomorphological investigations around the south-eastern lobe of the ice-cap and studies at the head of Clyde Inlet and Sam Ford Fjord, where he paid particular attention to the various beach levels and their Pleistocene fossils. He found that the ice-cap is at present in a comparatively stable state and he has already published a paper on the development of the moraines. He also observed that in the neighbourhood of Generator Lake the past direction of ice flow was from the south-west, indicating that not very long ago there was a large centre of accumulation, perhaps on the Foxe Basin coast of the island, from which the ice flowed out and down the many fjords of the east coast. During his work in this area he proved his enthusiasm by stripping four times daily to cross a lake by the camp. The directions of former ice movement in some of the connecting valleys near the coast were also studied by the Swiss mountaineers.

My own special interest was in glaciology, and we had a strong team operating on the ice-cap and making many diverse observations. Glaciological techniques are still in an early stage of development and we made many errors and learnt many lessons. One of our projects was to try and do what the Swiss and British scientists had done on the Aletsch Glacier; to sink a tube into the ice-cap to record flow data. In 1951 the Arctic Institute's "Snow Cornice" Expedition got a tube down to nearly 1000 feet on the Malaspina Glacier, but these parties had been dealing with warm ice at or around the pressure melting point, whereas on the Barnes Ice Cap we found temperatures of from $-10°$ to $-14°$ Centigrade. The result was that our hot-point melting apparatus soon ran out of power and the tube re-froze; the deepest hole we were able to achieve was 70 feet. There is therefore still about 900 feet of aluminium tubing lying around on the ice-cap. We had planned to dig a big pit in the firn at the central ice-cap camp, but we soon found to our surprise that there was only about 1 metre of snow, both here and at the highest point of the ice-cap, resting directly on solid ice. Nevertheless we discovered by continuous observations throughout the summer that there was in fact a growth of the ice-cap in its higher regions by direct

re-freezing of the melting snow (about 5 inches). It seems quite possible that this process may occur in other Arctic ice-caps where the annual mean temperature is low and where neither altitude nor precipitation are high. The melting off of the snow made ice-cap travel quite difficult during the latter part of July and early August. Rivers broke out with almost explosive force as the water content of the snow increased, and avalanches of slush ran at walking or running speed along the gently sloping surface. When it came to walking from the central station to the ice-cap margin, as I myself did several times, there were a good many of these rivers to cross, all posing a problem when equipment had to be pulled or carried. This condition made things hard for the surveyors who were carrying out gravimetric observations in an attempt to find the thickness of the ice. The method, which is of course open to some possible errors, requires rather accurate levelling, but we did achieve three radial traverses from the central station to the edge and four shorter traverses. The results indicate that the ice is up to 1500 feet thick in places, and that the rock floor below it is quite gently undulating and of the same general level as that of the surrounding countryside. At the central station, in addition to carrying out measurements of the ablation of the snow and ice, we took careful meteorological readings not only at the surface but at the top of a tower 7 metres high. There was often a surprising inversion of temperature which gave one a feeling of increasing warmth as one climbed the tower. Only for a brief period at the central station, from about July 31 to August 5, was the ice bare of snow, and then came the beginning of the next winter snowfall. I was up there when we evacuated the camp on August 27 and three of us pulled some 700 lb. of equipment down to a lake at the ice-cap edge, where the float plane could pick us up.

Such, rather briefly, are the scientific results of the expedition. We had examined in fair detail a small section of this great Arctic island, and now I hope to organize another somewhat similar venture to another part of Baffin Island for 1953. In particular, our glaciological findings lead us to inquire whether on the much higher ice-cap, the Penny Highland of Cumberland Peninsula which rises to 8000 feet, there is not some firn snow and a more normal process of glacial accumulation and ablation. This area offers too an excellent field for research in other sciences. I hope that I may be able to get a good many of the 1950 team together again. There is however one member whom we will not be able to obtain: Maurice King, the pilot of the aircraft, whose brilliant flying not only contributed enormously to the success of the expedition, but whose cheerful personality was always a lift for the morale of each camp he visited. Maury, flying the same Norseman plane, with Foresta and Valerie Wood, was lost in the Seward Glacier area in the summer of 1951. This accident has been a grievous personal tragedy for my colleague Walter Wood, and to the Arctic Institute as a whole. We can replace an aircraft, but we cannot replace those who were aboard.

This Society has been told the story of many great and fundamental journeys of exploration. The account I have given is of no such great adventure; we are today living in an age which is perhaps an intermediate one—the small-scale map of the earth is already covered with the names of the pioneers of the difficult routes across its surface. In the near future, the chart of the

solar system will list the names of new pioneering voyages of adventure. I believe it may well be that this second Elizabethan age is going to see the beginning of that pattern, and I believe that men from these shores will be in the forefront, even as Martin Frobisher and John Davis were the first to reach Baffin Island under the first Elizabeth.

Those of my generation must be content with less history-making work. But I believe that ample rewards are still there; there are many journeys to be accomplished on scientific trails, there are still countless problems to be solved of the life, of the rocks, and of the physical characters of the Arctic and Antarctic regions. And the thrill of treading the vastness of the tundra, and especially of treading it alone, is still there and is certainly for me sufficient reward in itself.

DISCUSSION

Evening Meeting, 25 February 1952

Before the paper the PRESIDENT (Mr. J. M. WORDIE) said: We are particularly fortunate in having Lieut.-Colonel Baird of the Arctic Institute of North America to lecture on his Baffin Island expedition in 1950. I feel unusually confident in giving you a short biography of Colonel Baird because my first acquaintance with him goes back to 1934 when he was an undergraduate at Corpus Christi College and joined the Cambridge expedition to Baffin Island, an expedition which had the good fortune also to include Dr. Tom Longstaff. It was then that Colonel Baird had his first experience of the Arctic and of this particular region, and he himself discovered the ice-cap which he is just about to describe. His companion, Mr. Montague Ritchie, also discovered a new fjord. In 1936 Colonel Baird returned to the Canadian Arctic with Mr. Tom Manning, when he was a member of a party of which practically all the members have since obtained a reputation in Arctic affairs, among them Mr. Rowley and Lieut.-Colonel Bennett. In 1938 Colonel Baird was again in the Arctic region, this time at Igloolik, and in 1939 returned to enter the Canadian Army. He joined up in a very humble capacity, but ended up in 1946 as commander of the great Arctic operation known as Exercise Musk-Ox, when those engaged, using "Snowmobiles," went across the tundra to Victoria Island and the western Canadian Arctic and back by the Mackenzie to Edmonton.

Colonel BAIRD: It is a great privilege and pleasure to speak to you to-night under the presiding hand of Mr. Wordie; he was my first mentor in exploration when I was the junior member of his expedition to West Greenland and Baffin Island in 1934. It was then that I first set foot on the soil of Canada, where I have now made my home, and I have been determined ever since to return one day to the fascinating region of Baffin Island. In reading over my diary I realize what an impatient young nuisance I must then have been to my leader; in 1950 I experienced some of the difficulties I must have caused him sixteen years before.

Colonel Baird then read his paper

The PRESIDENT: We have with us this evening Professor Sigurdur Thorarinsson of Iceland, who replaced Professor Hans Ahlmann, when he became Ambassador to Norway, as Professor of Geography at Stockholm. Since then Professor Thorarinsson has returned to Iceland and is now Director of the Department of Geology and Geography in the Museum of Natural History at Reykjavik.

Professor SIGURDUR THORARINSSON: I have been interested in Baffin Island since my childhood because, according to Icelandic classical literature, Baffin Island was discovered by Icelanders in about A.D. 1000 when they probably also discovered many other northern lands. The Icelanders named Baffin Island "Halluland," which means the Land of the Big Black Stones. I wonder whether the expedition in 1950 noticed any special features round the shore of Baffin Island which might have given rise to that name, because the early explorers used to name places after some peculiar feature. That might provide a clue as to whether or not Baffin Island was the land the early Icelanders actually discovered.

There are in Iceland ice-caps of about the same area and thickness as that on Baffin Island and rising also from flat land. While the ice-caps in Iceland are about the same thickness they are physically of quite another type, because the climate in Iceland is much more maritime and the temperatures much higher than those in the far north. It would be interesting to be able to compare the life of glaciers in Iceland with the life of those in Baffin Island. Finally, what did the expedition discover in regard to the withdrawal of the glaciers as a result of their study of the lichens?

Colonel BAIRD: We found that during the last one hundred years the glaciers had remained more or less stable; there was no appreciable withdrawal.

The PRESIDENT: Perhaps Lord Tweedsmuir would like to add a word or two? He has been with the Hudson's Bay Company.

Lord TWEEDSMUIR: I would like to add the words of a plain man to the words of the distinguished Icelandic scientist who has just spoken. Colonel Baird and I have much in common: we are both Border Scots, both Baffin Islanders, we have both served in the Canadian Army and we both, surprisingly enough, became Lieutenant-Colonels. I feel that having seen the slides illustrating the paper you will know the answer, if you are ever inclined to pose the question, as to why men go and live in such forsaken and uncomfortable places. Half the answer was given you in the slides for there you saw the sheer breath-taking beauty of Baffin Island and the far northern latitudes.

Listening to Colonel Baird to-night was a great revelation. If I cannot claim to be young I can, nevertheless, claim to be not unduly old I spent 1938 in southern Baffin Land, not as a distinguished scientist and explorer but as one of the employees of the Gentlemen of England trading into Hudson's Bay. I was a sub-Arctic stock-keeper and in the course of my stock-keeping duties and one visit to my next-door neighbour, who lived 250 miles away from my head-quarters, I did the better part of 2500 miles of dog travel. To-night we saw hardly a dog-team on the expedition and yet in the old days they were the usual means of travel. Times have certainly changed.

I went to Canada first in 1936. Things had been bad at the end of the nine-teenth century, but the frontier on the west had become a frontier no longer. People were slow to realize that the new frontier was on the north. What had seemed like a great mass of useless rock was beginning to be perceived to be the lid of the greatest treasure-house the world has ever seen. In those days the north was strategically unimportant, but with the war it was to gain a steadily growing importance in the eyes of not only Canada and the United States but of the whole free world; from the point of view of strategic vitality and also in the realization of its potential wealth.

In the past things were done on a smaller scale. In 1938 I remember going out into Hudson Bay in the Company's old ice-breaking ship, now I fear at the bottom. One day I was in the chart room with the Captain and I asked: "Will you show me where we are " to which he replied: "Take a look at the

chart on the wall. It is the latest Admiralty chart, and by that chart we are 150 miles inland!" That gallant little ship broke her back on the granite ridge in Hudson Strait about four years ago, but she reminds me of Mr. Tom Manning, an old friend of Colonel Baird and an old friend of mine, who has been mentioned several times this evening as the Chairman of the Board of Governors of the Arctic Institute of North America. I remember his wedding on board the *Nascopie* in Cape Dorset, which was where I kept my dogs. I was best man; the wedding ring was a copper washer out of the engine-room. All has now changed, and we realized to-night that in these days stores can be sent by boat in advance of explorers who land from the air and carry out their work in a few short summer months; whereas in the old days one had to take into account distance, provisions for the party and so on before setting out on an expedition.

In the strange, complicated, tortured world of today two of the greatest difficulties which confront an explorer are currency and politics. There is much of the world to which one cannot now go for the purpose of exploration If one went, one would be turned back. There are many other parts of the world to which one could go, but owing to the serious barriers of currency it is almost impossible to explore them. And it is by no means easy to outfit in Great Britain an expedition to the Canadian Arctic and at the same time obtain the necessary Canadian dollars. We are fortunate therefore, both in Britain and in Canada, to have the Arctic Institute (whose active Director is Colonel Baird, and whose Chairman of the Board of Governors is my old friend Tom Manning) going all out in their exploration of this great northern wonderland of theirs. The cooperation between Canada and Britain in this matter is absolute, and what the Canadians learn we learn as well. I feel sure I speak for everyone present when I say that we wish the best luck in the world to Colonel Baird and Tom Manning in all their efforts.

THE SURVEY OF INDIA SINCE THE SECOND WORLD WAR

BRIGADIER G. F. HEANEY

IN CONSIDERING a title for this paper my first thought was to call it "The Survey of India since the partition of India." Further reflection showed that this would be misleading; it would indicate that the big changes in policy in the employment and organization of the Survey of India were the result of the termination of British rule and the partition of India. In fact they were not, but have resulted far more from economic and world conditions arising since the war than from political changes in India itself. The partition of India and the termination of British rule altered the area of responsibility of the Survey of India and caused serious difficulties by the departure of experienced British officers; it did not however affect the general lines on which the Survey of India was working, except perhaps to increase potential demands for cadastral surveys from areas which had formerly been ruled by Indian princes. Of this I shall have more to say later.

The history of the Survey of India

Except just round the foreign settlements on the coast, no land surveys in the modern sense of the word had been made before the Franco-British wars of the Carnatic, in the days of Dupleix, and before the coming of Robert Clive to Bengal in the middle of the eighteenth century. The interior of India was then known only from travellers' tales. During the extension of British influence in the latter half of the eighteenth century British surveyors gave a good start to surveying by route traverses and astronomical fixings. These were mostly made by military officers marching with troops or on political missions. By the year 1800 political stability had been achieved in south India and this permitted the beginning of scientific survey work. Two great surveyors, William Lambton the geodesist, who in 1802 began the geodetic triangulation of India, and Colin Mackenzie who in 1815 became the first Surveyor General of the whole of India, laid the foundations on which the work of the Survey of India has since developed. Both were Army officers.

Mackenzie began systematic detailed surveys and aimed at completing one area and producing topographical maps on the 1-inch to a mile scale before moving on to the next. Revenue surveys on large scales were started in Bombay about 1812, and in Bengal some ten years later. These revenue surveys became of increasing importance and gradually developed into the elaborate field-by-field cadastral surveys that formed a distinct branch of the Surveyor General's department during the latter half of the nineteenth century. After Lambton's death, his work was carried on by George Everest,[1] who in 1830 started the Great Trigonometrical Survey of India in its modern form and attracted to its service the first of a succession of very able officers, mostly military engineers, who not only extended the principal triangles

[1] Whose name was subsequently given to the mountain.

throughout the length and breadth of the country but introduced and developed the important geodetic activities of high precision levelling and tidal, gravity and astronomical observations which have ever since remained important activities of the Survey.

In the interests of economy, every effort was made in the nineteenth century to draw general maps from the revenue surveys; purely topographical surveys were in general confined to the less inhabited portions of the country. As the revenue surveys made no attempt to indicate the topography of uncultivated land, and as there was no attempt to cover the whole of India with a continuous topographical survey, large areas were left blank or mapped in patches. The only continuous map was the $\frac{1}{4}$-inch to a mile 'Atlas of India.' Soon after 1860 Thomas Montgomerie, who had been responsible for the survey of Kashmir, inaugurated the regular employment of special surveyors for trans-frontier exploration. These surveyors, often in disguise, penetrated northwards through the mountain barriers on the frontiers of India and brought back route surveys of Tibet and other little known lands beyond. In 1867 the Surveyor General's department, which was divided into trigonometrical, topographical and revenue branches, was officially designated the Survey of India.

Early in the twentieth century a strong demand was made, more especially by the army and the various engineering departments of the Government, for better maps. As a result a large increase had to be made in the establishment of the Survey of India, and to provide for the enormous amount of work required for the programme of new topographical surveys, it was reluctantly decided to throw responsibility for all revenue surveys on to the local or provincial governments. Looking back, this decision seems to many of us unfortunate; but the urgency for new topographical surveys was so great that something had to go. A new topographical survey was begun in 1905 with a view to covering India with contoured maps, published in colours, on the scale of 1-inch to a mile. The intention then was to complete this new survey in twenty-five years and to revise it at twenty-five-year intervals. A short time later it was decided that surveys on the scales of $\frac{1}{2}$-inch or even $\frac{1}{4}$-inch to a mile would be adequate in the less developed parts of the country.

From 1905 until 1939 the chief preoccupation of the Survey of India was the execution of this new programme of surveys and mapping. Shortage of money and the diversion of part of the resources of the department to other types of work delayed progress, which after 1939 virtually came to a standstill owing to the war. The result was that when India was partitioned in August 1947, about 180,000 square miles of what then became India, including Hyderabad, but excluding Kashmir, were not covered by modern style surveys; and about another 340,000 square miles were covered by modern style surveys more than twenty-five years old, many of them badly in need of revision. Since then Kashmir has acceded to India and the figures given above must be increased. By the end of the war it was also beginning to be felt that a larger scale than 1-inch to a mile was required for topographical maps in areas likely to be of commercial or strategic importance and a decision was made to provide 1/25,000 scale topographical surveys in such areas. (Fig. 1.)

Towards the end of hostilities in the Second World War, it became evident

in India that, owing to the growth of population and the loss of Burma rice, increased agricultural production would be one of the main necessities of the country in future. This position was later aggravated by the loss of wheat, cotton and jute growing areas to Pakistan. As a result, a very large number of multi-purpose projects, some of which were new and some of which had been investigated before but pigeon-holed, came under active consideration. There was an immediate demand for surveys in connection with these projects and

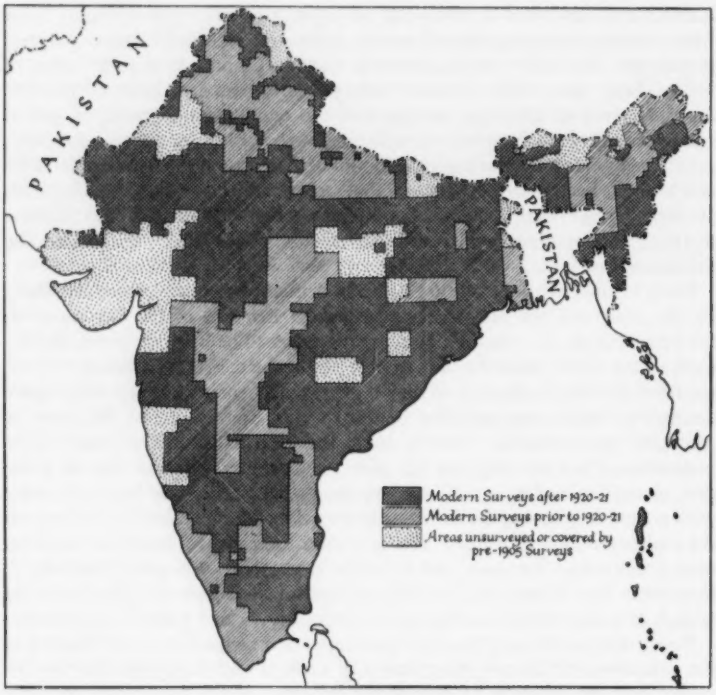


Fig. 1. The progress of topographical survey

this demand fell almost entirely on the Survey of India—as being the only organization with a staff capable of undertaking the work.

The close of the war and the subsequent partition of India gave a great stimulus to geodetic and geophysical work. This has largely taken the form of demands for high precision levelling to provide basic data for irrigation and power projects and for gravity surveys to assist exploration for oil by geophysical methods. There has also recently been renewed interest in tidal observations, the data on which tidal predictions are based being in many cases old and inadequate. The increase in civil aviation after the war also made it apparent that special aeronautical maps would soon be required, although for

a time this demand was met by the supply of maps prepared for the air forces during the war.

Summarizing what has been said above, the situation facing the Survey of India after the war was:

(*a*) A very large area of the country was still not covered by the series of 1-inch contoured surveys which had been begun in 1905; and a demand was already making itself felt for topographical maps on a larger scale.

(*b*) There were pressing demands (i) for surveys for multi-purpose projects, chiefly on the 4-inch to a mile scale with close contouring; (ii) for gravity surveys to provide a basic framework on which detailed investigations could be made by others; (iii) for high precision levelling to control the project surveys; and (iv) for new tidal observations and modern methods of tidal computation.

(*c*) A new commitment had been undertaken for the production of special maps for Civil Aviation.

The cost of surveying since the war

At this point I must make a digression. The surveyor like most other people is largely governed in his methods and organization by economic considerations. In the past, one of the sources of justifiable pride of the Survey of India was in its plane-table surveyors. These men, who generally had little education, were recruited on very low pay and were equipped with very simple instruments. By rigorously eliminating unpromising pupils, a large body of plane-tablers was built up which carried out admirable topographical surveys, especially on small scales. Each plane-tabler had a squad of about five *khalasis* (survey labourers) to do chaining, carry instruments, etc., and who, before the war, were paid an average wage of about *Rs.*14 per month. The plane-tabler himself received on an average about *Rs.*70 a month. Local transport was also usually very cheap and easily procured. The result was that small scale topographical surveying by plane-table in India was very inexpensive.

The rise in the cost of living since the war and the introduction of the New Pay Code early in 1947 has completely altered the position. The plane-tabler who before the war cost *Rs.*70 now costs an average of *Rs.*130 per month, while the cost of keeping a *khalasi* in the field has jumped from *Rs.*14 to about *Rs.*75 per month. The cost of local transport has gone up in similar proportions. And, in common I believe with workers throughout the world, the plane-tabler is not prepared to work such long hours as he did in the past. The result of all this is that, far from being cheap, plane-table surveys now cost about four times what they did before the war, and we have been forced increasingly to turn to other methods.

Since 1925 the Survey of India had been using air photography for survey purposes. On the old North West Frontier its use was forced on us owing to the inaccessibility of the area to plane-table surveyors. Elsewhere the practice was to use graphical methods of plotting to obtain the outline of topographical features from the photographs, while contours were generally obtained by ground work. Here, too, we were taking advantage of cheap

labour; but as this is not now obtainable for survey work, India in common with most other countries will in future, so far as can be seen, carry out more and more of its work by air survey methods using automatic plotting instruments such as the Multiplex and Wild A-5 and A-6. For some years past the Government of India has had a contract with a firm which specializes in air survey and air photography for survey purposes to supply the department with the photographs it requires. The Survey of India has recently installed three tables of Multiplex plotting equipment, and hopes to install more plotting machines in the future. These should reduce costs by cutting down considerably the amount of ground work required and increasing the output per man.

Events at the partition of India

No account of the Survey of India in recent years would be complete without some reference to the events of 1947 when British rule terminated and India was partitioned.

For some months prior to the change which occurred on 15 August 1947, the shadow of great impending political changes affected all considerations of policy and planning. I remember listening to the radio with a group of others at the club one evening in June 1947 in Dehra Dun. The Prime Minister of India Mr. Jawaharlal Nehru, Mr. Jinnah for the Muslim community and Sardar Baldev Singh for the Sikhs all made speeches announcing their acceptance of the plan for the partition of India. Somebody remarked to me "It looks as though you will have to get moving pretty soon." This proved to be somewhat of an under-statement. Within a few days I received a telegram from the Government of India instructing me to put up detailed proposals, within what seemed a very inadequate time, for the complete partition of all assets, including personnel, of the Survey of India between India and Pakistan. We certainly had to act quickly, though our problems could have been no worse than those of other all-India departments.

We were fortunate in having a survey office established in Murree in the northern Punjab, in the area which is now Pakistan, and so had some nucleus on which to build there. As far as possible, all personnel opting for Pakistan were transferred before August 15, and so avoided moving during the period of maximum disturbance in northern India shortly afterwards. I think I am correct in saying that there was no loss of life amongst Survey of India personnel as the result of the communal riots following partition. In Delhi we had some anxious times with certain of our Muslim staff who did not wish to go to Pakistan. It became necessary to transfer them out of Delhi, and they asked to go to Calcutta which was then quiet. Their Hindu colleagues were very good in lending them clothes to disguise themselves; they were taken down to the station dressed as Hindus, complete with sacred cords, and were shepherded to an inconspicuous place in a third-class compartment in the train, where it was hoped their obvious agitation would not betray them. At the last minute, just as the train was about to leave, a party of formidable-looking bearded individuals armed with long swords entered their compartment to the great consternation of the disguised Muslims. Considerable apprehension was felt about the possible fate of our people after the train

started, but we were glad to receive a telegram a couple of days later announcing their safe arrival in Calcutta.

For the Survey of India, the effects of partition on personnel were for a time almost crippling. The majority of the British officers who were holding the senior posts left within six or seven months. Among the lower paid technical staff there was a very high proportion of Muslims, nearly all of whom went to Pakistan, and this left us with a great shortage of plane-tablers, traversers, draftsmen and map reproduction technicians. We found ourselves for a time quite unable to meet the majority of demands made for surveys. In August 1946, just a year before partition, the Government had sanctioned a considerable increase in the establishment of the Survey of India in view of the increased demands for its services. The loss of our British and Muslim personnel made our establishments look very empty. A recruiting programme was undertaken but this had the effect of accentuating the shortage for a time, by removing some of our more skilled remaining personnel as instructors.

After a short period of uncertainty the Government of India agreed that the pre-partition establishments should, with one or two unimportant modifications, apply to the India remaining after partition. This was in effect a second increase in the establishment of the Survey since the war, as the area now to be covered was considerably smaller than it had been. The effect of this double expansion, combined with the loss of senior officers, resulted in the promotion of officers to senior positions which a few years previously they could never in their wildest dreams have aspired to occupy. In those very disorganized times due consideration could not, unfortunately, always be given to merit, and not all those promoted have proved themselves worthy. The most remarkable feature of this rapid promotion has however been its illustration of the adaptability to responsibility of many individuals. It would be incorrect to say that there have been no lapses from proper standards of technical or administrative efficiency, yet the results of these promotions have certainly been much better than most people expected. More recently the Government of India has enforced a policy of rigid selection of those best qualified for promotion, without undue regard to seniority, and this has given openings for many very promising junior officers. By the end of 1948 the corner had been turned and the efficiency of the Survey was definitely improving.

The composition of the Survey of India

Before the war the majority of executive officers (those in charge of field Survey Parties, Drawing Offices, etc.) and the higher administrative officers, were commissioned officers of the Royal Engineers. These constituted the Class I Service; below this was a service of junior gazetted officers recruited in India from college graduates; this was the Class II Service. Below this again were Upper and Lower Subordinate Services of technicians. The former were recruited from those with educational qualifications of not less than Intermediate standard; the latter had no particular educational qualifications and comprised the bulk of the plane-tablers, traversers, levellers and other field staff.

An interesting development has been the attitude of the independent Government of India towards the employment of regular military officers of

the Corps of Engineers in the Survey of India. For some time before the termination of British rule there had been a tendency in certain government quarters to deprecate the employment of military officers in civil departments such as the Survey of India; and shortly before partition it was decided that the composition of the Class I service would be 37½ per cent. military officers, 37½ per cent. directly recruited civilian officers, and 25 per cent. officers promoted from lower services. Since partition however, the armed forces have shown an increasing interest in the Survey of India and it has now been decided that the Surveyor General of India shall always be a military officer and that 50 per cent. of the Class I service shall in future be recruited from military officers, at the expense of the quota of directly recruited civilians. It has also been decided to keep a Military Survey Service in existence in peace time.

Before the war the Survey of India was responsible for military survey preparations, the link with the Army being a staff captain at Army Headquarters in the Military Intelligence Branch of the General Staff. The new Military Survey Service is very small and has inadequate personnel to carry out more than a limited amount of technical work, and such staff duties as the Army requires in peace time. The bulk of military survey and mapping requirements are therefore still met by the Survey of India. To secure coordination and make the best use of the limited resources available, the Surveyor-General of India is, in peace time, also the Director of the Military Survey Service. Under him on the military side is a military staff paid entirely by the Army. In order to provide the Military Survey Service with trained survey officers the Survey of India will arrange to post back its military officers periodically for tours of duty with the Military Survey Service.

The spelling of geographical names

One of the responsibilities of the Survey of India is for the spellings of geographical names; and during the last few years this has been a constant source of concern. In the days of British rule the *Gazetteer of India* was the authority for the spelling of all names appearing in it, and it was the responsibility of the Surveyor-General to bring to the notice of the authorities the need for any changes in *Gazetteer* spellings. If a name did not appear in the *Gazetteer of India* the authoritative spelling was that appearing on a modern Survey of India map. The normal way of obtaining this spelling was to get the best version of the name spelt in the local script, obtain the concurrence of the local civil authorities and then to transliterate this into Roman script according to the recognized system of transliteration. This was all right for names written in the Urdu or Devanagri scripts used in northern India. A weakness of the system was that there were no standardized systems of transliteration applicable to some Indian languages, especially those of southern India such as Malayalam, Telugu and Tamil. As English was very largely used in southern India the usual practice was to apply to the Provincial authorities, ask them for the spelling in Roman characters and accept that.

Another difficulty has arisen from the fact that when the Hunterian system of transliteration was adopted in about the 1880's certain well-known geographical names were allowed to remain unchanged, although it was recog-

nized that they were not correct transliterations of the spellings in the local script. Examples are the names Ganges, Delhi and Cawnpore, which if correctly transliterated should be Ganga, Dehli (from the Urdu) and Kanpur respectively.

Under the newly approved Indian Constitution the aim is to adopt Hindi, written in the Devanagri script, as the national language of India in fifteen years. It seems certain however that, for some time at least after that, it will still be necessary for the Survey of India to produce editions of the maps of India in the Roman script. From the time of the adoption of Devanagri as the national script, the authoritative spelling for any Indian geographical name will be the Devanagri version of it, and the Roman version will be this name transliterated into Roman characters according to the recognized system of transliteration. As we have just seen however, there is no recognized system of transliteration into Roman of many Indian scripts; still less are there recognized systems for transliterating all the Indian scripts into Devanagri. Until these systems of transliteration are agreed on, any attempt to change names in Roman script now might merely result in the name having to be changed again on the adoption of Hindi as the national language.

In view of this, and of the seriousness of changing a name already well known throughout the world, the Central Government in India has been very cautious about adopting any changed spellings of names. Unfortunately the Provincial (now State) governments have been by no means so cautious, and shortly after partition some of them set about issuing revised spellings of many names in their territories without apparently recognizing the difficulties that might be involved, or without consulting the Surveyor-General. Certain Central Government departments, such as Posts and Telegraphs, followed suit. Had these changes in spelling been merely to correct obvious errors in such existing spellings as Cawnpore for Kanpur, not much harm would have been done. Unfortunately, some of the revised spellings are just as wrong as those they sought to correct; and many of them are not even consistent among themselves. For example, many southern Indian names terminate in what the British spelt "patam," such as Vizagapatam and Seringapatam. This word should really be "pattnam" (meaning "town"). In the revised spellings issued by the State government this is variously rendered "pattnam", "patnam" and "patinam" and, in the absence of standardized systems of spelling and transliteration, it is impossible to say which is correct; all one can say is that all three can hardly be right.

Central Government departments have now agreed not to alter further names or adopt new spellings without consulting the Surveyor-General, and so have all the State governments with one exception; so it is to be hoped that before long something will be done to systematize spellings. I think it fairly certain that some of the changed names, such as Kanpur, will be adopted but I would not like to hazard a guess about the future spelling of names such as Delhi.

Survey work carried out since the war

I now propose to give a brief account of the survey work carried out since the war. I include some details of the project surveys as the scope of the

projects may be of interest. The main survey work on which the Survey of India has been engaged can be conveniently divided into the following classes: (*a*) Regular topographical surveys for standard Survey of India map series on the 1/25,000 and 1-inch to a mile scales; (*b*) geodetic and geophysical survey work; (*c*) project surveys; (*d*) cadastral surveys; and (*e*) training. I give below some account of each of these classes of work.

Regular topographical surveys. Owing to the urgency of demands for other work, little progress has been made since the war in the completion of the programme of topographical surveys begun in 1905. A few thousand square miles have been surveyed in Bombay State where the existing maps were from uncontoured surveys upwards of seventy years old. A beginning has also been made on the 1/25,000 series in Kutch, in connection with the new port of Kandla.

Geodetic and geophysical surveys—geodetic triangulation. The whole topographical survey programme of the Survey of India is based on the network of geodetic triangulation largely completed in the last century. Many of the stations of this triangulation were on brick towers which have since fallen down. Other stations have been lost; and there is now a definite danger that sections of this geodetic framework may be completely lost. We were fortunate in getting a set of Bilby portable steel towers from American disposals shortly after the war; I have often wondered just why the American forces brought these Bilby towers to India, as they certainly never used them there, but I am very glad that they did. The towers were tried out on the triangulation in connection with the fixation of the East and West Bengal boundary astride the Ganges, where they have proved a success. We shall also use them largely in connection with the rehabilitation and strengthening of the geodetic triangulation framework; it is hoped to begin a regular programme in the near future. Since the war we have re-observed and strengthened some geodetic triangulation in Kutch where it was urgently needed in connection with surveys for the new port of Kandla. We have also begun a new geodetic series which will cover the Andaman Islands. This work, which should have been finished early in 1952, had to be discontinued in 1951. It is interesting to note that precise observations for latitude and longitude in the seasons 1950–51 have resulted in a correction of +30″ to the previously accepted longitude of Chatham Island, the datum station for the latitude and longitude of the Andaman Islands. The extension of the high precision level net has made some progress and has been given considerable stimulus by the demand for levelling for irrigation projects.

Tidal observations. The demand during the last few years for the development of the Indian Navy and mercantile marine has focussed attention on the need for improved tidal predictions for Indian ports. The Survey of India has been making tide predictions for many years for many of the ports on the Asian shores of the Indian Ocean, but the observations on which predictions are made are generally old, and were often somewhat inadequate in the first place.

We are now installing a number of automatic tide gauges at the more important ports. A field party has also been employed for the last couple of seasons doing twenty-nine-day observations at numerous new ports, and this

will enable tide tables to be prepared for them also. Our tide predicting officer was sent to the Tidal Observatory at Liverpool in 1949 for a course in the latest methods of prediction; and we have accepted the view of the Director of the Liverpool Tidal Observatory that our present tide predicting machine, which has been in use since 1888, is inadequate. We have accordingly ordered a new machine with forty-two components and hope it will be ready for use this year.

Magnetic survey. We had hoped to resume work on magnetic observations, but unfortunately funds have not permitted the establishment of a new magnetic observatory near Dehra Dun in place of our old one which was rendered useless by the encroachment of buildings and electric power lines.

Gravity observations. As I have already noted briefly, gravity observations have received a great impetus since the war as there is a strong desire on the part of the Government of India to exploit oil and mineral resources to the full. A couple of years ago we purchased a modern gravimeter and have been carrying out observations in areas which the geologists consider promising for mineral prospecting. The function of the Survey of India in this work is to provide a network of gravity stations throughout India which can be used by geologists and others engaged in mineral and oil prospecting, as bases for their detailed work in particular areas. We hope to purchase in the not too distant future a gravimeter of another type which it is felt may be more satisfactory for the particular type of work we require.

Project surveys. I have referred above to the great demand for project surveys and the location of the principal surveys we have undertaken in this connection is shown in Figure 2. The most common type of project is for a combination of purposes, such as the generation of hydro-electric power, irrigation, flood control and soil conservation. The normal scheme of such projects is for the erection of a dam in a river gorge and the use of the impounded water for irrigation and the production of electric power. In the preliminary investigations, the work required of the surveyor is to outline the area that will be flooded if a dam is made at a selected location and of a given height. Contoured maps or contoured air photo-mosaics are therefore required to enable the engineers to estimate the volume of impounded water. A large-scale survey, generally on a scale of about 1/2400, is also required of the dam site. The third and much the largest task is to survey the area to be irrigated. Generally maps of the commanded area are required on a scale of 4 inches to the mile, with contours at 1- or 5-foot intervals; and a large number of bench marks have to be sited at regular intervals on the ground. The object of these maps and surveys is to enable the engineers to make a preliminary siting of their canals and distributaries on the map, and to do the final layout on the ground.

The main surveys of this kind that we have carried out recently have been in connection with the following projects:

(1) *The Mahanadi project*, near Sambalpur in Orissa. This whole project envisages the construction of three dams at Hirakud, Tikkapara and Naraj. The first named has priority and the survey work is complete, and work has already begun on the construction of the dam. The objects of this project are flood control in the Mahanadi delta, the generation of electric power, the

irrigation of about 900,000 acres, and an improvement in navigability of the Mahanadi river itself. I understand that the work on the Hirakud portion of the project is scheduled to be complete within five years.

It is interesting that there was much local opposition to this scheme, not only as might have been expected from those who would lose their lands and homes through flooding by the reservoir, but also by those whose lands would be irrigated. Their argument was that their taxation would go up, they would have to work harder to pay it, and would in many cases have to

Fig. 2. Project surveys [1]

grow two crops in a year where one had previously been enough for their needs. The opposition took the form of removing bench marks, and in some areas about a quarter of the bench marks set up in one year were found to have been removed when work was resumed the next year.

[1] The projects numbered in Figure 2 are the following: 1. Kakarpara dam and reservoir; 2. Kakarpara commanded area; 3. Tungabhadra commanded area; 4. Hirakud dam and reservoir; 5. Tikkarpara dam and reservoir; 6. Naraj dam and reservoir; 7. Hirakud commanded area; 8. Bhakra-Nagal dam and reservoir; 9. Bhakra commanded area; 10. Damodar valley; 11. Damodar valley commanded area; 12. Kosi commanded area; 13. Gandak Barrage commanded area; 14. Kistna dam and reservoir; 15. Pennar dam and reservoir; 16. Kandla port development.

(2) *The Kosi project.* This relates to the construction of a very high dam in the gorge where the river Kosi leaves the hills in Nepal. The proposed dam is to have a height of about 780 feet, which I think would make it the highest dam in the world, and the main purpose of the scheme is flood control of the Kosi (Bihar's Yellow River) which floods annually, and frequently causes untold devastation in the plains of Bihar by changing its course. In addition to the high dam, a barrage is to be constructed a few miles lower down. Survey work on this project was stopped in August 1950 and I am not sure when construction work will begin. The dam would be uncomfortably close to the epicentre of the very severe Bihar earthquake of 1934 and the rate of silting would also be likely to cause difficulty.

(3) *The Bhakra–Nangal project.* This envisages a dam about 680 feet high across the river Sutlej in the Punjab, near the point where it leaves the hills, and another dam at Nangal about 8 miles downstream. Survey work on the areas to be irrigated by this scheme has been going on intermittently for many years but has recently assumed very high priority; work on the Nangal dam is already under way. From this an extensive canal system will take off and eventually, should the whole scheme come to fruition, large quantities of electrical power will be available as far afield as Delhi; the irrigation will transform arid areas like Hissar district in the East Punjab, which suffer from chronic shortage of rainfall and periodic famines.

As most of the area which will be served by the Bhakra project is not fully cultivated, the main task of the surveyor is to divide this land into rectangles of 3000, 100 and 25 acres respectively. At the corners of these rectangles stones are embedded, the heights of which are fixed by levelling. The survey work thus serves the double purpose of dividing the land into a system of rectangular plots and covering it with a close network of bench marks. It is anticipated that power will be available from this project by 1952 and that 6·6 million acres of land will be irrigated, 1·6 million acres of which are now waste land. The whole scheme is scheduled to be completed by 1955–56.

(4) *The Damodar Valley project.* This was originally intended for flood control but now has developed into a multi-purpose project envisaging several storage dams with hydro-electric plant in the valley of the Damodar. Some of the first surveys for this project were done at the end of the war by a military survey unit largely manned by Survey of India personnel awaiting demobilization. Recently, surveys of the area to be irrigated have been undertaken on contract by a private firm specializing in air survey and the Survey of India is also taking up some of the work.

(5) *The Tungabhadra project.* This is a joint enterprise by Madras and Hyderabad and will result in the irrigation of about 300,000 acres in the State of Madras and another 670,000 acres in Hyderabad State; in addition a large amount of electrical power will be generated. The Survey of India has carried out surveys of a very large area in the State of Hyderabad and it is hoped that the whole scheme will be complete by 1954.

I have mentioned a few of the main undertakings, but the Survey of India has also worked since the war on numerous other projects of which the more important are the Tista project (which was abandoned after the partition of Bengal), the Gandak project which will irrigate large areas in Bihar, and

the Kakarpar project on the river Tapti in Bombay. A project of a different kind which deserves some mention is the development of the port of Kandla at the eastern end of the Gulf of Kutch. Considerable survey work was required and surveys of the Rann of Kutch are now being asked for in connection with the exploitation of ground water in the region.

Cadastral surveys

I noted towards the beginning of this paper that after the reorganization of the Survey of India in 1905 the responsibility for cadastral surveys passed entirely to the Provincial governments. Speaking as a surveyor I do not think that the result was a success, though it may have been inevitable in the circumstances of the time. The consequence has been that little was done by the provinces after 1905 to establish or preserve the survey marks which could have been used as starting points for fresh surveys. The staffs of Provincial survey departments are often unqualified for anything but the most rough and ready surveys and much of their work would not stand up to examination. So far this state of things has caused little serious harm, though on occasions it has led to much expense. For instance, in the fixing of the disputed portions of the boundary between East and West Bengal we had to discard any attempt to use provincial survey data for the framework on which the boundary was to be fixed, and had to go back to the geodetic triangulation stations. Some of the new State governments are however beginning to realize the need for more attention to accurate survey work and are tending to turn to the Survey of India for advice and assistance.

Many of the former princely States, which have now been either consolidated or merged into the former Provinces, had no proper land-revenue settlements; and so have very large cadastral survey tasks in front of them and no adequate survey staffs to carry them out. The Survey of India has been so short of staff itself since the war that it has not been able to render the help required, but its advice is frequently sought; and all States, with one or two exceptions, have accepted the regional Directors of the Survey of India to be their advisers on survey matters. It is hoped that as the officer situation eases in the Survey of India it will be possible to second officers to the States to assist them with their survey problems. A beginning has been made with the State of West Bengal, to which we have lent a Survey Officer who continues to work under the technical direction of the local regional Director of the Survey of India.

Training

Prior to the partition of India, the training of surveyors was carried out in the Abbottabad area in the North West Frontier Province as this had a climate which enabled field work to be carried on for practically the whole year. After partition the training of plane-tablers was moved to the Bangalore area, where the country is suitable for most types of survey work and the climate permits of outdoor work for most of the year.

The training of officers is now carried out under the orders of the Director, Geodetic and Training Circle, at Dehra Dun. All Class I and Class II officers go through a very complete course of training on joining and have,

at the end of it, to sit for an examination of the standard of the Intermediate Examination of the Institution of Surveyors (India). For those who pass, courses are held at Dehra Dun during the summer to prepare them for the final examination of the Institution of Surveyors. By thus insisting on a thorough theoretical and practical training at the outset of their careers it is hoped to raise the general technical standards of officers.

Trans-frontier exploration

For the last century and a half surveyors and explorers based on India have played a very large part in central Asian exploration. The area north of India has long provided the adventurous with a field for exploration and with the opportunity for filling important blanks on the map. Non-official explorers and travellers could count on the support and assistance of the Survey of India. Though their governments did not encourage strangers, the countries immediately north of what is now India were not regarded as potential routes of approach for an aggressor and few or no restrictions were put on the publication of maps covering the northern Indian frontiers and beyond, from Kashmir in the west to Assam in the east, and any new information about these areas was made public.

Now the situation has changed. Faced with uncertain political conditions in the countries to the north, the Government of India has been obliged to restrict all maps on topographical scales which cover the northern frontiers and beyond. (See Fig. 2.) Such maps will not be available, as in the past, just for the asking nor will it be possible for the explorer beyond the northern borders to publish his results for the information of all the world. It is a sad thought that the days of trans-frontier exploration of the Survey of India are gone; but in a rapidly changing Asia it seems inevitable that it should be so.

No paper of this sort would be complete without some reference to the future of the Survey of India. We have keen and promising young officers coming on, and there is no doubt that the Government of India increasingly appreciates the work of the Department. Given good and progressive leadership and enough money, there seems to be no reason why the Survey of India should not maintain its position as one of the great survey departments of the world, and continue its contributions to science.

DISCUSSION

Afternoon Meeting, 11 February 1952

The CHAIRMAN (Brigadier M. HOTINE) said: For the benefit of those who have not yet heard of Brigadier Heaney I should like to say that he has recently retired from the post of Surveyor-General of India and that he is going to speak to us on the work of his department since the Second World War. His work covered the difficult period following the partition of India, so that he had to reorientate the work of the department over that period.

Brigadier Heaney then read his paper

Brigadier SIR CLINTON LEWIS: As an old member of the Survey of India I have been much looking forward to Brigadier Heaney's paper. He has told us

of the problems of the hand-over but has left us to infer his own personal difficulties as first head of the Department under the new regime; I know they have been considerable. He has told us about the current work and the special surveys which have been undertaken since the war. I should like to say a word or two of the old days, the heyday of the programme of regular topographical survey.

India has perhaps more variety of country than any area in the world of comparable size. I spent my first field seasons down in the far south, in the then unexplored forests of Travancore. We were surveying the catchment area of the Periyar dam where the elephant grass was 10 feet high and, quite unaccountably, one might find oneself in the middle of a herd of elephants a hundred strong or more. The natural reaction was to make for the nearest tree, not that that was much good because anything small enough to climb was small enough for an elephant to knock over. Elephants in the herd are however docile and move off when one makes enough noise. In the forests the trees were so high that pigeons on the topmost branches were out of gun-shot range—or I should say, out of my gun-shot range.

At that time Burma was part of the Indian Empire and we surveyed the Irrawaddy delta, where the jungle is probably as impenetrable as anywhere in the world. Fortunately we did not have to penetrate it, as we did the survey from the air. Quite different again was the Indian desert, the shifting sand dunes of Bikaner and Jaisalmer; in some places the wells were over 400 feet deep. The biggest contrast of all is of course in the Himalaya, the Karakoram and the Hindu Kush, about which we have heard so often in this hall. Between the wars, regular surveys were undertaken in Chitral, Garhwal, Kumaon and Sikkim. This led to the training of a selected band of Indian surveyors, not only in high mountain plane-tabling, but also in the craft of the climber and, as we have been told, many of our surveyors accompanied private expeditions to the mutual advantage of the Department and the explorers. We now learn that much of the northern frontier region is unfortunately closed for reasons of security.

We had a great regard for the Indian plane-tabler, and indeed for all the Indian personnel of the Survey of India; I think the *khalasis* of those days were tougher than now. When we were in camp, some of them would be sent out once a month with the surveyors' mail and pay packets and they would think nothing of covering 200 miles in three or four days; 50 or 60 miles a day at a steady jog-trot through the night with a few hours' rest in the middle of the day, taking their meals from the wayside villagers. In those days government messengers could demand meals from villagers as an immemorial right. Nowadays they usually proceed by country 'bus. Then there was the *tindal*, the headman of the *khalasis*, one of whose jobs was to run the check lines. He would be shown a distant point, a prominent tree or hillock 3 or 4 miles away, to which he was to run his chain. The terminal point was out of sight half the time, but he would keep a perfectly straight line and laboriously record in his notebook the points at which it crossed roads, streams and so on. When at the end you checked the work, he made a point of giving all the distances from memory and never referred to the notebook unless some discrepancy in the surveyor's work came to light.

The Indian surveyor had a great sense of loyalty. In the areas we surveyed there might be many hundreds of square miles of dense forest and it would have been easy to "fake" the remoter parts; he would know that an inspecting officer could not go everywhere, especially where communications were almost non-existent. In high mountains it would have been much easier to sketch in

what he could see and guess what was round the corner, rather than climb a high peak or a difficult glacier. Yet, by and large, there were few lapses of that kind. We tried to build up a tradition of integrity and I hope and believe that the Government of India will uphold and foster that tradition in the future. That goes for Pakistan also.

Professor KENNETH MASON: I have enjoyed Brigadier Heaney's lecture very much indeed. It is twenty years since I left the Survey of India and I was there for twenty odd years before that. Much of my service was, under a kindly Government with kindly Surveyors-General, in the disputed part of Kashmir which is one of the most pleasant countries in the world to survey. I spent seven years there and I have travelled in the eastern Himalaya also.

I should like to make one or two points, not so much on the survey side because it is not the Surveyor-General's Department which is concerned; I have in mind the danger inherent in some of the big schemes in the eastern part of India and the Ganges plain. One great danger is that of trying to harness the waters of such a river as the Tista, which has changed its lower course half a dozen times in four hundred years, at one time flowing into the Brahmaputra, at another time into the Ganges. I hope the engineers in India realize the great changes that will take place when they try to control a river of that type. Flood and scour are immense forces with rivers having a Himalayan and monsoon regime. I have also in mind the Ganges itself; its lower course, too, has changed considerably during the last four hundred years. In early Tudor times it came down the Hoogly past the present site of Calcutta. It is, I believe, only since 1787 that it has taken approximately its present course.

Then there are the engineering projects for the rivers of eastern Nepal. Why put up enormous "Boulder Dams" on those rivers in an unstable earthquake zone? There are two or three big thrust planes in the outer Himalaya here and, it is believed, a new boundary fault. I should have thought it most dangerous to build high dams in that area. The annual rainfall at Darjeeling is 122 inches a year, of which over 100 falls in three months. In the catchment of the Kosi there must be an average of 80 inches of rain falling in the three months when glaciers are still melting; I cannot conceive how all this water is to be controlled behind a dam. Fortunately it will not be the Surveyor-General's business if the dam gives way. Nor can I really see why there is any need for a project of this kind at Damodar; I believe Brigadier Heaney said that it was for the purpose of draining and controlling the water rather than for irrigation.

Brigadier HEANEY: It was originally a control scheme but the present Government have enlarged its scope to cover power and irrigation.

Professor MASON: Why irrigation? In the eastern plains of northern India the endeavour is always to get water off the land because there is too much; in the north-western plains water has to be conserved because there is too little. There does not seem to be much object in spending vast sums of money in that connection.

I do congratulate the Survey of India on maintaining their manifold activities, tidal, magnetic and so on, all just as before, and I also congratulate the Surveyor-General on having made such a magnificent job of it.

Mrs. HALEY: Will the Colombo Plan, inaugurated by the United Nations, finance any of these projects in India as a part of South-east Asia?

Brigadier HEANEY: That is a little out of my province. I understand however that the Government of India is obtaining funds from the World Bank for some of the projects. I do not think that the Colombo Plan has got to the extent of allocating funds for definite projects but I imagine that the Government of India will ask for funds in due course.

Mr. C. PAPE: Has the Survey of India moved its headquarters to Hathibarkala or is it going to do so?

Brigadier HEANEY: The Surveyor-General's headquarters, comprising the purely administrative offices of the Department, were in Delhi from 1941 until 1950, when they were moved to Mussooree. They have now moved down to Dehra Dun and are situated in the old Geodetic Branch compound and not in the Hathibarkala estate.

Mrs. SHAW: It was not clear from what the Surveyor-General said whether the senior officers of the Survey of India were recruited from the British or the Indian Army.

Brigadier HEANEY: For many years the system of recruitment was to take three officers from the Royal Engineers (who are British Service) and one British officer from the Indian Army. Between the two wars, when it was desirable to Indianize as much as possible, the recruitment of Indian instead of British officers from the Indian Army was begun; when the Corps of Indian Engineers was formed, the recruitment of Indian officers was confined to that Corps. The result was that when the last war broke out the majority of military officers in the Survey of India were Royal Engineers, there were also a few British officers from the Indian Army; we also had two Indian officers from the Indian infantry. It was soon after the outbreak of the war that Indian officers from the Corps of Indian Engineers were posted to the Survey.

Mrs SHAW: What is the present proportion of English officers; is it the intention of the Government of India to continue to employ them?

Brigadier HEANEY: I cannot work out the proportion! There are now two British officers in the Survey of India and there will be only one in a few months' time. It is certainly not the intention of the Government of India to retain more British officers than are absolutely essential; I think they will eventually do without any.

The CHAIRMAN: It is now abundantly clear to all of us that the Survey of India has accomplished an enormous amount of work during the last few years, work of a most diverse nature. It is amazing that the Survey has been able to carry on with its purely scientific work, as well as work on the projects about which we have heard, during a period when the Survey might have been forgiven for spending a good deal of time on what I first described as reorientation and re-administration. It only remains for me to ask you to thank Brigadier Heaney for his most interesting lecture.

THE CHANGING PHYSICAL LANDSCAPE OF BRITAIN

S. W. WOOLDRIDGE

IT IS MORE than half a century since William Morris Davis, having learned the physiographic lessons of the American South-West and applied them in the Appalachian country, visited Britain. His visit revived interest in British landforms, at the same time giving it a new direction. In his famous paper published in the *Journal* in 1895 he sketched the physiographic evolution of south-east England.[1] The central feature of his interpretation was his recognition of the widespread hill-top plain of the area regarded by him as an example of an uplifted and dissected peneplain, his own term for that undulating surface which marked the termination of a long continued cycle of erosion.

Let us recall in imagination that most famous and extensive view of southern England which we obtain from the tower on the summit of Leith Hill. Here, just above 1000 feet above sea-level, our prospect embraces a dozen counties. The natural horizon line is some 40 miles distant but the actual view, given maximum visibility, falls short or ranges further than this with the accidents of relief. What renders the view signal and notable is the fact that the major hill ranges of the south country lie, for the most part, near the horizon circle and thus frame the regional picture. To the north-west the skyline is the level crest of the Oxfordshire Chilterns, continued north-eastwards to the Dunstable Downs and, on a clear day, even beyond the Hitchin Gap to the Chalk ridge south of Royston. Westwards and south-westwards the view is restricted by the high bastions of the Lower Greensand at Hindhead and Blackdown but behind them the western Downs above Selborne present a crest as level and featureless as that of the Chilterns. It is continued in the summit line of the South Downs and the high central Wealden crests of Ashdown Forest. In the northern foreground, seen in much greater detail, the North Downs present a similar even summit.

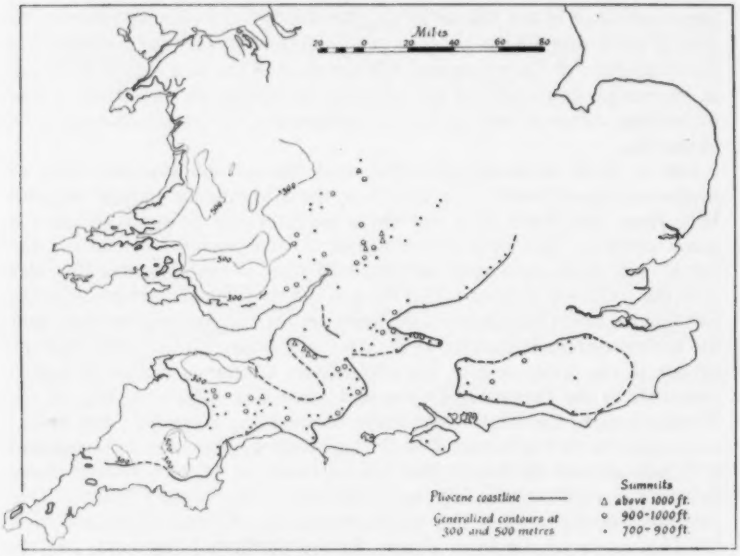
In these facts lies the evidence for the theory that the south country has been sculptured from an uplifted plain of which relics are preserved in our highest hill summits. A plane 800 feet above sea-level would, indeed, pass close to all these summits. Leith Hill (965 feet), Blackdown (918 feet) and Hindhead (890 feet) would exceed it, as would also the highest points of the North Downs (877 feet), the South Downs (880 feet) and the Chilterns (852 feet). Crowborough Beacon (792 feet) just fails to reach it, as do many parts of the Chalk crest-lines. These summits, and others over a wider area, are shown in the figure on page 298.

This peneplain was regarded by Davis as the product of the age-long waste and river action which ensued in mid-Tertiary times, after the strong earth ripples, distant ground swell of the Alpine storm, had thrown the south country from Kent to Somerset into parallel ridges and furrows and thus

[1] "The development of certain English rivers," *Geogr. J.* 5 (1895) 127–46.

given birth to the first decipherable drainage system in the area. These first rivers produced the plain; thereafter, as it was uplifted, they dissected it, bringing into being the graceful lines of the present landscape with its broad lowland vales separated by scarp-bounded uplands through which the rivers, older than the hills they traverse, wind in narrow defiles.

Davis thus recognized an ancient land surface. In its later development, physiographic work in the south-east has become a study of this and other surfaces of differing dates and various degrees of preservation. There is indeed a true geology and geography of surfaces, distinct from, though not unrelated to, that of former sea bottoms and their wide sheets of stratified



Pliocene coastlines and ancient summit levels

sediments. The geomorphologist in seeking to take on the tale from the hands of the stratigraphical geologist finds himself, in the words of T. H. Huxley, seeking to use "sea reckoning for land time" and the difficulties of so doing are formidable. The hill-top plain of southern England may be reckoned, in this sense, a Miocene surface; the product of atmospheric action during that Miocene period which, alone among the major time divisions of the geological past, is unrepresented by stratified rocks in Britain.

If we are to use the south-east as a clue and a measure for other British regions we must take note of the fact that two other well-marked surfaces can be traced in its landscapes. Younger than the main hill-top plain is the broad bench, cut largely in Chalk, on which the remnants of marine Pliocene deposits are widely distributed. This was not treated by Davis for, though Pliocene submergence was in his day known to have occurred in Kent, the

full extent of the sea was not then recognized. The character of the deposits themselves, their occasional fossils, and above all the evidently wave-cut flat on which they rest and which is recognizably preserved even when the deposits have been removed, have since enabled us to trace the former extent of the sea. In making the reconstruction shown in the map, Professor Linton and I were guided by a further important consideration—the relation, or rather lack of relation, of much of the drainage to the structure of the underlying rocks.[1] When England south of the Thames was first raised into closely spaced ridges, the main lines of drainage must have followed the furrows between them. But that is not at all what we find over much of the main belt of folding today. Frequently and systematically, north–south rivers cross the east–west fold axes at their strongest development. This is notably true in Sussex and throughout the Wessex Chalk area, where it was first clearly perceived by Linton. It was a major defect of the Davisian hypothesis that it failed to account for such features. It is true that the first cycle of erosion would have obliterated the anticlinal crests, but if the present drainage were merely successor to that of the first cycle it could not, save by the local accident of river capture, have so developed as to cross the line of strong anticlinal folds. What is required to account for the facts is a new start for the drainage such as must have followed the spreading and subsequent uplift of a sheet of sand and shingle over parts of the old plain. It is worthy of note that it was Davis's student and chief successor, Douglas Johnson, who first hinted to us that an extension of the Pliocene sea into Wessex would satisfactorily account for drainage features otherwise hardly explicable.

Throughout the greater part of the area the Pliocene shelf or platform is backed by a low bluff separating it from higher ground—part of the mid-Tertiary plain. This bluff fixes the position of the coastline.[2] It is a feature of the greatest significance that the platform maintains a very uniform general level of about 600 feet. It slopes seaward from between 650 and 700 feet at the base of the bluff to about 550 feet or a little lower. This shows beyond question that the late Tertiary uplift of much of south-east England was uniform, *i.e.* unaccompanied by faulting or bending. On the Essex coast however, and northwards into East Anglia, Pliocene deposits contemporary with and later than those of the London area lie but little above sea-level; in Holland they are far below it. Thus is exemplified one of the later expressions of a long-established and recurrent tendency for the east coast region to be tilted towards the North Sea depression.

Excluding this eastern zone, the physiographic development of the area has consisted in the uplift and dissection, stage by stage, of the Pliocene sea floor and the adjacent parts of the mid-Tertiary plain. The stages of this uplift are marked by the minor platforms and terraces, essentially old valley floors, of which the district presents a complex but coherent record. The chief of

[1] 'Structure, surface and drainage in south-east England,' *Inst. Brit. Geogr.* Pub. No. 10, 1939, pp. 48 *et seq.*

[2] It is particularly to be noted that in the Central Wealden area, which is regarded as lying beyond the limits of the Pliocene trespass, the drainage retains its dominantly longitudinal lines. This provides confirmatory evidence and guides the reconstruction, but since there is no coastal bluff here the argument must not be permitted to beg the question.

these are marked by surfaces at about 400 feet north of London [1] and, more widely spread, the dissected plain, now about 200 feet above sea-level. This was formed before the main ice advance into the region, for much of the glacial and associated deposits rest on it.[2] Dissection has however revealed a regionally much more important surface, the early Tertiary plain on which the main mass of the Tertiary (Eocene) deposits rest. The Chalk sea floor was raised into land and subjected to long erosion before the earliest Tertiary deposits were laid down; it must have been far advanced towards peneplanation before the waves of the Tertiary seas completed the levelling process. It is sometimes exposed in deep excavations through the Tertiary cover but it has been laid bare by the clipping back of this cover on the margins of the London and Hampshire basins. It necessarily shared in the Alpine movements and thus is, normally, tilted at a considerable angle.

If we turn now from south-east England towards the uplands of the west and north there are thus three main surfaces, the early and mid-Tertiary plains and the Pliocene marine bench, which we might hope to find there represented.

Let us first pass westwards beyond Abbotsbury where the restored Pliocene coastline crosses the present coast. In east Devon a similar feature recurs as part of a whole series of platforms. If we traverse southwards from Honiton along the ridge of Farway Common and Broad Down and thence to the coast near Branscombe, we descend a gigantic physiographic stairway each of the treads of which was interpreted by the late J. F. N. Green as a marine platform.[3] At the highest level, at about 800 feet, is the great plateau which also extends 10 miles north of Honiton to the scarp of the Blackdown Hills. This surface might well commend itself as the continuation of the hill-top plain of the south-east, cut here in the Upper Greensand. Green however regarded it as an old sea floor, finding traces of rolled shingle upon it at Ottersford and elsewhere. South of Broad Down we descend to a lower surface at about 650 feet and roughly a mile wide. This is replaced as we approach the main Exeter–Lyme road by still another with its back at about 600 feet. Nearer the coast a narrower flat comes in at about 530 feet, ranging almost to the cliff top.

If we group together the two surfaces between 700 and 530 feet, they form a feature very similar to the Pliocene bench further east and the coastline of the time can be tentatively reconstructed as following the main bluff below 700 feet. It is however clear that we are offered an almost embarrassing number of such surfaces, which if they are correctly interpreted as marine strand-flats plainly record a shore line retreating during mid-Tertiary times under the influence of long-continued but spasmodic uplift. We select this example for special mention because here, in east Devon, we are still within the province of the rocks of the English lowland. All these surfaces are cut in Upper Greensand and are necessarily at least post-Cretaceous in age. Comparable regular sequences of platforms have been shown to occur below 1000 feet throughout much of our south-western and western coastlands, in

[1] S. W. Wooldridge, *Proc. Geol. Assoc.* 37 (1927) 107.
[2] *Ibid.*, 39 (1928) 1.
[3] *Proc. Geol. Assoc.* 52 (1941) 36.

the Bristol district, Devon and Cornwall, South and western Wales, the south and west coasts of Ireland and the Lake District. They present a difficult and very disputable body of evidence. I have recently reviewed and discussed this evidence as a whole and will not enter fully into it here.[1] The most effective brief summary of the facts has been given by Hollingworth [2] who made a statistical analysis of the hill-summit heights of large parts of our western uplands. He found frequency maxima at the following chief heights: 320 feet, 430 feet, 560 feet, 770 feet, 900 feet, 1040 feet and 2000 feet. His method cannot distinguish between marine and river cut flats, but the results certainly suggest the conclusion that much of Britain has suffered spasmodic uniform uplift. This is of course to make the large assumption that coastal flats at the same altitude but at widely separated points are of the same age. Our present evidence may suggest but it certainly cannot prove it.

We may pause in our westward traverse on the summit of the Haldon Hills, south of Exeter. Here we are still on the Upper Greensand and our summit is evidently a continuation of the 800-foot flat of east Devon, but we are less than 20 miles from the high summits of Dartmoor which present their characteristic profile from across the deep intervening rift valley of Bovey Tracey. Devon and Cornwall continue and supplement the physiographic record of our lowlands, but they introduce also the very different problems of our uplands. Unglaciated, they have borne the full brunt of Tertiary uplift and erosion. Here, if anywhere, we may hope to find the essential clues to the history of the British land surface, but the record is hard to read and much work remains to be done. In 1909, using Devon and Cornwall as a comparator in his study of glacial erosion in North Wales, W. M. Davis interpreted the landscape in terms similar to those he had used for south-east England.[3] The granitic uplands stood as residuals above an uplifted peneplain, the product of an earlier cycle of erosion but now dissected, with lowlands opened up along the softer rocks of the eastern margin. Only a year before, George Barrow had proposed a very different alternative line of interpretation in his paper on the high-level platforms of Bodmin Moor.[4] Here and on the flanks of Dartmoor we find extensive flats cut indifferently across the structure, and maintaining for long distances altitudes of about 1000 and 800 feet respectively. The 400-foot coastal flat, prominent throughout Cornwall, was already well known and linked, though rather dubiously linked, with fossiliferous Pliocene deposits. Its precise age is still disputable but it is beyond question a marine strand-flat backed by a degraded cliff. Barrow interpreted the higher platforms as similar but older features. We note at once the absence of a 600-foot platform from the sequence; its presence has however been claimed by Balchin on the flanks of Exmoor and by Green in the region of the Dart valley. There are also clear signs of its presence along the northern side of Dartmoor and the southern side of the Bodmin upland.

In terms of platform sequence the terrain of older rocks in Devon and Cornwall can thus sustain a similar interpretation to that of the east Devon

[1] *The Advancement of Science*, 7 (1950) 162.
[2] *Q.J. Geol. Soc.* 114 (1938) 55.
[3] *Q.J. Geol. Soc.* 65 (1909) 291.
[4] *Q.J. Geol. Soc.* 64 (1908) 384.

plateau region. When we turn however to greater altitudes on Dartmoor and Exmoor new problems emerge. Is it here that we may hope to find relics of one or other of the two great Tertiary plains of the south-east? Before making such a claim we must recall that the lowland rocks, notably the New Red Sandstone and the Chalk, must once have extended widely beyond their present limits in the south-west. We are left thus with the question, how far the arid climates of New Red Sandstone times or the waves of the Upper Cretaceous sea may have left their mark on the surviving high country of the south-west. To this question we shall attempt, for the moment, no direct answer. Let us adopt rather the strategy of indirect approach, returning to south-east England and passing thence *via* the Cotswolds to Wales.

Standing at 856 feet at Uffington Castle on the Berkshire Downs, our view ranges across the upper Thames valley to the Cotswold summits 40 miles distant. Here at Cleeve Cloud and Broadway Hill the scarp crest just exceeds 1000 feet. These points, taken with the other high Cotswold summits, seem to indicate that we have again found remnants of the great mid-Tertiary plain. We must note, indeed, that the gap between the Chalk and Oolite crest is a wide one and unbridged by linking summits. If however we entertain the not unreasonable hypothesis that the two crests are, broadly, relics of the same surface we naturally turn north-westwards where our view embraces such summits as Worcestershire Beacon (1395 feet), Brown Clee (1790 feet) and the Stiper Stones (1731 feet). If we seek to include these heights in our former plain we find that its rate of westward climb is accelerating; but taken by themselves we must admit that these summits are too few and far between to subserve much more than idle speculation. From the Stiper Stones however we may get a magnificent prospect of that much more impressive feature, the high plateau of Wales. In North Wales its general level is about 2000 feet. Above it Plynlimon (2468 feet), the ring of peaks around the Harlech dome (Cader Idris, the Arans and Arenig) and those of Snowdonia rise distinctly. South of Plynlimon the general surface declines gently southwards, reaching about 1500 feet in Mynydd Eppynt where it is overlooked by the scarp of the Old Red Sandstone, in its culminating points overtopping 2000 feet for a distance of nearly 40 miles. South-westwards the descent is even longer continued; there is no obvious break until a level of 1000 to 1200 feet is reached in north Pembrokeshire where the Prescelly Hills (1760 feet) rise suddenly from a generally lower surface, just as do the high peaks of North Wales.

There has been wide divergence of opinion as to the age and origin of the Welsh plateau; here indeed the issue is fairly joined between two radically contrasted modes of interpretation. Ramsay first recognized the great surface a century ago and saw it as a plain of marine denudation. If marine denudation is in question we are faced with our ignorance of the extent to which marine Jurassic formations may formerly have covered Wales. A more likely agent of planation would however be the waves of the Chalk sea; this was the view taken by A. J. Jukes-Browne[1] who, in effect, regarded the higher standing residuals as relics of islands in the Cretaceous sea. But in 1909 Davis[2]

[1] 'Building of the British Isles,' London, 1922, p. 334.
[2] Davis, *op. cit.*, 1909.

View from Gibbet Hill, Hindhead: the plain of the Weald Clay, the Lower Greensand escarpment, and the North Downs in the background

proposed an early or mid-Tertiary date for the surface, inclining to the latter alternative. He was making the correlation which our westward view from Broadway Hill might suggest, and claiming once more that the hilltop plain was a mid-Tertiary feature as in south-east England and in Devon and Cornwall. In the following year W. G. Fearnsides regarded the surface as probably an early Tertiary surface of sub-aerial denudation. Twenty years later in a most important address O. T. Jones,[1] while admitting the possibility of Jurassic or Cretaceous marine action, stressed the great efficacy of planation under the desert climates of New Red Sandstone times. He quoted Davis's paper on the cycle of arid erosion and the work of Passarge in South Africa which showed that the desert plains are "not undulating, with low hills, but true plains of great extent from which isolated residual mountains arise like islands from the sea." To such a description the Welsh plateau certainly conforms satisfactorily though it bears evidence of subsequent tilting. Professor Jones has recently returned to the subject in an address on the drainage system of Wales.[2] He still regards the high plateau surface as primarily due to the New Red Sandstone erosion but accepts the hypothesis that the drainage began on a Chalk cover and thinks it "not improbable that the uplift of the area . . . may have begun in the early Tertiary but attained its culmination in the Miocene." He also finds evidence of a lower surface along the main drainage lines, controlled by a base level at about 600 feet, and a coastal surface similarly related to a 400-foot base level.

The latest paper that bears on our problem is that of D. L. Linton[3] which is concerned to define the form of the original land block from which Scotland has been carved. In the Scottish Highlands, Ben Nevis and the great Cairngorm plateau rise to over 4000 feet, above the "Grampian main surface" at about 3000 feet. Linton adopts the working hypothesis that these summits mark fairly closely the level of the base of the former Chalk cover. Pursuing this line of argument southwards, he has distinguished each summit "which is the most easterly of its altitude in its own latitude and is not flanked by higher summits north and south on its own meridian." Between the plotted points rough form lines have been drawn, and these define a generally easterly slope from Caithness to Devonshire. Such a slope is consonant with the fact that the original direction of the drainage over most of Britain appears to have been easterly.

We cannot discuss here the many implications of Linton's stimulating paper. It must suffice to note for our purposes two aspects only. In Wales, Linton's reconstruction is consistent with either of the leading views on the Welsh high plateau. His form lines are drawn through the residual summits, and if these mark the base of the Chalk they leave room in most areas for a sub-Cretaceous cover of Mesozoic rocks resting on a Palaeozoic floor produced by arid or marine erosion. If such were the case we should conclude that the vast periods of Tertiary erosion spent themselves in stripping this floor of its cover and exhumed it largely intact. If, alternatively, following

[1] "Some episodes in the geological history of the Bristol Channel region" (Presidential Address to Section C), *Rep.* Brit. Assoc. 1930 (1931).

[2] Abs. *Proc. Geol. Soc. Lond.*, No. 1475, 1951.

[3] *Scot. Geogr. Mag.* 67 (1951) 65.

The view westwards from Blackdown: the inward facing escarpment of the Fernhurst anticline

Davis, we infer that Tertiary planation itself has left its mark on the present face of Wales, removing a Chalk cover and cutting a plain below its base, such inference is not inconsistent with Linton's reconstruction.

Further south difficulties arise; Linton includes in his control points the summit of Cleeve Cloud on the Cotswolds. It is unlikely, though perhaps not impossible, that the Chalk ever rested here; but in any event one cannot safely assume that its own lower member, the Gault-Upper Greensand, was missing. This however hardly involves more than a minor correction. It is more important to notice the large divergence of view implicit in regarding this point alternatively as on a sub-Cretaceous and a mid-Tertiary surface. Still further south the lines of Linton's reconstruction cross Dartmoor. The Dartmoor summits certainly conform to a plane sloping south-eastwards at rather less than half a degree, but J. F. N. Green[1] has given reasons which appear sound for regarding this surface as of early Tertiary date and there are other strong reasons for doubting whether the Cretaceous base can here have had this simple form. It was necessarily involved in the strong Alpine folding, certainly traceable as far west as Somerset, not to mention the considerable faulting which gave rise to the Bovey Tracey rift.

Space will not avail us to discuss here the problems of the Pennine upland. It must be sufficient to say that they are in all respects similar to those of Wales. On the one hand the high summits have been claimed as representing one or more Tertiary peneplains, while in the south the general upland plain of the Peak District has been supposed to represent the sub-Triassic surface.

The objects of this paper have been definite and limited. It seeks to indicate though not to solve some of the leading problems confronting British geomorphologists and to illustrate the methods and arguments employed by them. Professor Darby, speaking as a historical geographer, recently sketched in broad review the changing British landscape in its human aspects.[2] Geomorphology is best seen as the historical geography of the physical landscape and, despite great differences in material and methods, the two studies show a strong basic kinship since both deal in terms of sequence and require an evolutionary approach. The chief difference between the two studies is however their own present state of evolution. Work on the changing human landscape in Britain is still in its earliest stages—it is a project clearly in view and actively in progress. The similar project for the physical landscape was announced and initiated by Davis fifty years ago. His lucid pen and graphic pencil bred a lineage of workers now in its second generation. A. J. Herbertson speaking to O. J. R. Howarth in 1901 referred to "this whole great new science" of geomorphology.[3] The claim was scarcely too high, and that it could be made at all was due essentially to the work of Davis. His American successors have recently reviewed and appraised his work.[4] If I venture here to add this brief tribute from Britain it is because of the great debt that many British workers owe to him.

[1] *Proc. Geol. Assoc.* 60 (1949), p. 105 *et seq.*

[2] *Geogr. J.* 117 (1951) 377–98.

[3] *The Advancement of Science*, 8 (1951) 158.

[4] "Symposium in geomorphology in honor of the 100th anniversary of the birth of William Morris Davis," *Ann. Assoc. Amer. Geog.* 40 (1950).

The record of the changing physical landscape of Britain proves, indeed, to be more complex and disputable than is suggested by the writings of Davis. The earlier British emphasis, not unnatural or inappropriate in our sea-girt island, was upon marine denudation. In part this proved demonstrably in error. Our lowland escarpments are not old cliff lines, though it is worthy of note that we have not yet reached the centenary even of this conclusion. That late Tertiary marine planation has left legible marks on our coastlands below 1000 feet is still a reasonable hypothesis with much evidence to support it.

The other chief point at issue has also been indicated in this paper. The lowland summits are parts of a surface which Davis and others have regarded as a peneplain of mid-Tertiary age. When we seek the corresponding surface in our uplands we confront the possibility that their own even skylines preserve evidence of much earlier phases of planation, notably that of New Red Sandstone times. This suggestion finds support in our growing realization of the vigour and facility of plain formation under the control of arid or semi-arid climates—a fact widely demonstrated in Africa. If our uplands retain relics of surfaces so ancient, it follows that they must register all later earth movements, so that in general they should be tilted or warped. Some of them indeed show clear evidence of such warping. But in some cases at least we may be justified in supposing that the surface marks the early Tertiary plain (p. 303) and that the warping was part of the Alpine movements. In general, the case for early Mesozoic planation in our uplands must be considered strong but unproven. It requires the unlikely but not impossible assumption that the great periods of early and middle Tertiary erosion peeled the later sedimentary skin from the uplands but left their core virtually untouched. It is perhaps not unforgiveable to regard this proposition with some reserve. If we accept it, and consent also to the claim of those who see evidence of marine planation as high as 1000 feet in the western coastal areas, there is no room left for the Davisian peneplain; if it ever existed it has been completely destroyed. As J. F. N. Green wrote in his last paper, "it would seem that the peneplain must ultimately disappear altogether from the English landscape."[1] Yet this may well prove a premature conclusion. We can return to our first view-point on Leith Hill and see a surface which is certainly Tertiary in age and yields no evidence whatsoever of marine origin. The essentials of W. M. Davis's view may yet be vindicated.

It will be clear that we have necessarily left untouched many cardinal aspects of our changing physical landscapes, notably the developing drainage pattern and the contribution of glaciation. It is true indeed that we have been pre-occupied with the earlier stages of our landscape evolution. But it is as true of physical as of human history "that nothing less than the whole of the past is necessary to explain the whole of the present." As James Hutton long ago wrote, on the sequence of terrestrial change, "in examining things which actually exist and which have proceeded in a certain order it is natural to look for that which has been first." The primary questions we have posed require an answer before we can see our changing physical landscape in its correct proportion and its full sequence.

[1] Green, *op. cit.* 1949.

DISCUSSION

Afternoon Meeting, 31 March 1952

Before the paper the CHAIRMAN (Professor J. A. STEERS) said: I have, in the President's absence, the pleasure of introducing Professor Wooldridge, though in fact he is too well known to you to need any introduction. He is a Professor at King's College, London, a former member of the Council of the Society and an active member of our Research Committee. He has been prominent in academic matters and I need hardly remind you that he is a leading authority on geomorphology. He was President of Section E at the British Association meeting in Birmingham, and he is President of the Institute of British Geographers. Professor Wooldridge's paper this afternoon can be described as a companion to Professor H. C. Darby's paper on "The changing English landscape" when he addressed the Society in January 1951. Professor Wooldridge is also making this an occasion to recognize and pay a tribute to the work of Professor W. M. Davis, one of the first to call attention to certain important changes in the landscape of England and Wales.

Professor Wooldridge then read his paper

Mr. E. H. BROWN: I should first like to thank Professor Wooldridge for his masterly and impartial summary. His tribute to William Morris Davis has ably filled a gap in our post-war literature. While still paying tribute to the lecture, I should also like to pay a tribute to Professor Wooldridge. So great is his interest and so freely given is his advice to all workers in the geomorphological field that when he says "our present state of knowledge" what he really means is largely *his* state of knowledge.

My own work has been concerned with Welsh geomorphological problems and I hope it may help to bring together seemingly divergent views if I suggest yet another possible origin for the Welsh upland plains. There are four distinct units in the landscape; we have heard of all of them in one context or another this afternoon. Firstly there is the high plateau, which I believe to be warped so that it now has a slight north to south gradient from Snowdon down to the South Wales coalfield. If we are correct in regarding the isolated summits of the Welsh border as remnants of this high plateau, then it has a much steeper gradient from west to east. Where it is best preserved to the south of Plynlimmon, it is gently rolling; convex slopes predominate, with low rounded summits and flat boggy hollows. Anything more like a typical Davisian peneplain is difficult to imagine. This, I would suggest, is an early Tertiary peneplain which extends eastward to include the borderland summits of the Longmynd, the Malverns, possibly the Wrekin and (here I differ from Professor Wooldridge) the summits of the Cotswolds, Cleve Cloud and Broadway Hill.

Above the high plateau rise, as has been so ably demonstrated already, a score or so of peaks which are in this view true Davisian monadnocks. Their summits may very well have been, as has been suggested by Professor Linton, carved from a higher, and possibly sub-Cenomanian, surface on which the drainage of Wales was initiated. The high pleateau has been greatly reduced in area. The prospect one gets of it on fine days gives the impression that the plateau is a dominating feature in the landscape of Wales, but if one looks for it on a map there is remarkably little of it because it is greatly reduced in area by the third unit in the landscape—what I believe to be a mid-Tertiary peneplain which is concave in form, unwarped and graded down to a height of about 800 feet: *i.e.* the lower summits of the Welsh border shown on Professor Wooldridge's map. The position of this surface is such that in part at

least it could be an exhumed sub-Triassic surface. It could also be, at least in the west, an integration of a series of marine-cut surfaces.

The fourth unit is the Pliocene marine-cut bench which Professor Wooldridge included in his reconstruction of the Pliocene shore line of southern England and Wales; it is the 600-foot platform in Wales.

Now the Cotswold summits are a positive link in the chain between the known east and the unknown west. I am here regarding them as part of an early Tertiary surface; which you will see forms a compromise between Professor Linton, who suggests a sub-Cenomanian age, and Professor Wooldridge who to-night links the summits of the Cotswolds with the mid-Tertiary surface of south-eastern England which he then projects into the high plateau of Wales. In south-eastern England the peneplain has a relief of the order of some 200 feet. Leith Hill is a prime example, rising some 200 feet above the general surface level. The Cotswold summits are, I believe, likewise residuals rising above this peneplain which occurs again, graded to about 800 feet, in Herefordshire. The evidence is the summits which Professor Wooldridge has plotted.

Dr. W. G. V. BALCHIN: I would first like to join Mr. Brown in thanking Professor Wooldridge for his stimulating address this evening. I feel myself that the broad survey is just as necessary as the detailed research paper and Professor Wooldridge can rest assured that this contribution will, in years to come, be as eagerly read as his many other studies.

He has of course touched upon many points that are still being actively discussed by geomorphologists, but in this brief comment time will only permit a mention of one major problem. This is the absence of any recognizable wave-cut bench or marine deposit above the 675-foot level in south-east England. On the other hand evidence of such action abounds in south-west England. I do not myself find this apparent contradiction so problematical as some geomorphologists do, for there is a reasonable chance that higher sub-marine platforms of Miocene (or early Pliocene) date would be extensively modified by sub-aerial agencies in the less resistant sands, clays and chalk of south-east England. The observant field geographer may yet provide us with the fragmentary remains of an ancient deposit to settle this problem.

My second point is rather more general. In listening to Professor Wooldridge and thinking around the title of the lecture, it seemed to me that in attempting to provide a physical counterpart to Professor Darby's lecture, the "changing physical landscape" might well be considered to fall into three distinct chapters. This evening we have listened to a masterly exposition of chapter one—the formation of the essential elements of our landscape by sub-aerial and sub-marine agencies throughout the Tertiary era. As our lecturer himself noted in his concluding remarks, time did not permit of more. But in post-Tertiary periods many profound events have taken place involving changes in the physical landscape which have in due course influenced human utilization of the terrain. My chapter two would therefore become a general consideration of the contribution of the glaciation of Pleistocene time to our present landscape; and my chapter three would concern itself with the changes on our coasts which have largely taken place in historic time. Here dramatic alterations bring home with clarity the existence of a changing physical landscape. A slice of Yorkshire coast a mile in width lost to us since Roman time, towns and villages disappearing into the sea off the Suffolk coast; but on the other hand 10,000 acres of shingle added at Dungeness, and the isle of Thanet now incorporated in the mainland. Vast accumulations of wind-blown sand in Cornwall and South Wales obliterating farms and churches; changes in sea-level which have produced indented coastlines and influenced the evolution of the

Fens and Broads. These and many other equally dramatic episodes spring to mind.

I hope therefore that Professor Wooldridge's lecture will be followed by other broad surveys contributed by eminent authorities who have studied the effects of glaciation and coastal changes in our evolving landscape. Meanwhile, we owe a great debt of gratitude to him for providing this evening the essential background, and for bringing to life so vividly the events which took place in that great chapter of Tertiary time.

Professor S. W. WOOLDRIDGE: It seems that all I need do in reply is to express my pleasure in the contributions of my two young colleagues, Mr. Brown and Dr. Balchin. I think Mr. Brown will probably prove his point; I certainly hope so. I am willing to accept the hypothesis that the great high plateau of Wales is an early Tertiary peneplain tilted and warped by the Alpine movement; it is a reasonable and attractive hypothesis and I think it important. I am also interested in Mr. Brown's suggestion that the summit surface of the Cotswolds must come into the same category, but it is certainly beyond my power to attempt to discuss that now; I have never really considered it.

Dr. Balchin's point, the absence of high marine levels in south-east England, is one I have often discussed with him personally and it admits of no answer. It is conceivable that at the levels about which I was speaking there may actually be evidence of an early marine planation but, if so, that evidence would at present help us very little. Looking at it from Dr. Balchin's point of view, I have tried to see how the matter could be tested. While I admit the possibility he indicates, I can see no evidence in the higher points of south-east England for anything but a Davisian peneplain. Yet at any moment observation might bring to light the evidence for which Dr. Balchin is explicitly asking The matter is not closed.

The CHAIRMAN: The subject matter of Professor Wooldridge's paper is somewhat off my own beat; but I welcome this series of lectures on the changing landscape of Britain. He has, as it were, prepared the "table," but there is a good deal to be said for the "table-cloth." For example, there is the coast. I should very much welcome a discussion in which Professor Wooldridge and others took part to debate not just the origin of the detailed features but that of the coast in its main outlines—the origin in fact of the seas around Britain. It would, I suggest, be profitable to do this during the next twelve months.

I am sorry that Professor Linton and Professor Hollingworth were unable to be present to take part in the discussion. On your behalf and my own I thank Professor Wooldridge for a most interesting and stimulating paper.

THE CAMBRIDGE SPITSBERGEN EXPEDITION, 1949

W. B. HARLAND

THE REGION VISITED by this expedition lies at the head of Isfjorden in central Vestspitsbergen and from the main base at Brucebyen[1] (Bruce City) we investigated the Scottish Spitsbergen Syndicate estates east of Billefjorden and the region north to Finnlandveggen (the Stubendorff Mountains) which lie to the east of Wijdefjorden.

Our programme was primarily geological, with the object of collating and continuing the earlier work of British geologists and this required a detailed compilation of unpublished data. In the field we completed a preliminary survey of the Permo-Carboniferous rocks and continued reconnaissance of the Pre-Devonian rocks to the north. We also began systematic work on soil polygons and carried on other subsidiary researches. This programme, which was selected for its scientific interest, was not unrelated to the economic potentialities of the area, which is the main British property in Spitsbergen. Our aim was to produce the most useful scientific results and at the same time to give experience in field geology to the members of the expedition, financial support for which had been received for training as well as for research. It has been argued that in such circumstances research suffers from inexperience, and training suffers from the priority given to results; this expedition aimed at a practical compromise between two more expensive ideals. We all learned from the experience, and the research profited by the efforts of each member.

The party consisted of R. G. Atkinson, M. H. P. Bott, C. W. Brasher, C. L. Forbes, W. B. Harland (leader), P. F. Hutchins, D. Masson-Smith, R. McWhae (deputy leader), R. O. Morris, J. S. Page, O. P. Singleton, R. J. Taunton and W. M. L. Wood. Eleven were students in the Department of Geology at Cambridge, some of them graduates working on Spitsbergen problems as research students and the others undergraduates who from experience with the Services and elsewhere were able to contribute in various ways both to the efficient running of the expedition and to the scientific work. All were able to carry some responsibility in organizing the expedition beforehand, and subsequently when working in the department. The selection of members from such a narrow field was intended to allow better coordination of the work in Cambridge.

The expedition was out of England from 6 July till 30 September 1949, arriving at Longyearbyen in a collier from Bergen on July 19 and leaving on board three colliers on September 14, 18 and 19. The field work conveniently divides itself into three periods. In July, half the party was engaged in coastal survey from two small boats while the other half was beginning work at base. During August three parties were in the field most of the time

[1] All place-names used in this account will be in the official form. See Place Names of Svalbard. *Skrifter om Svalbard og Ishavet*, No. 80, 1942. Names since 1942 have been approved by Norsk Polarinstitutt.

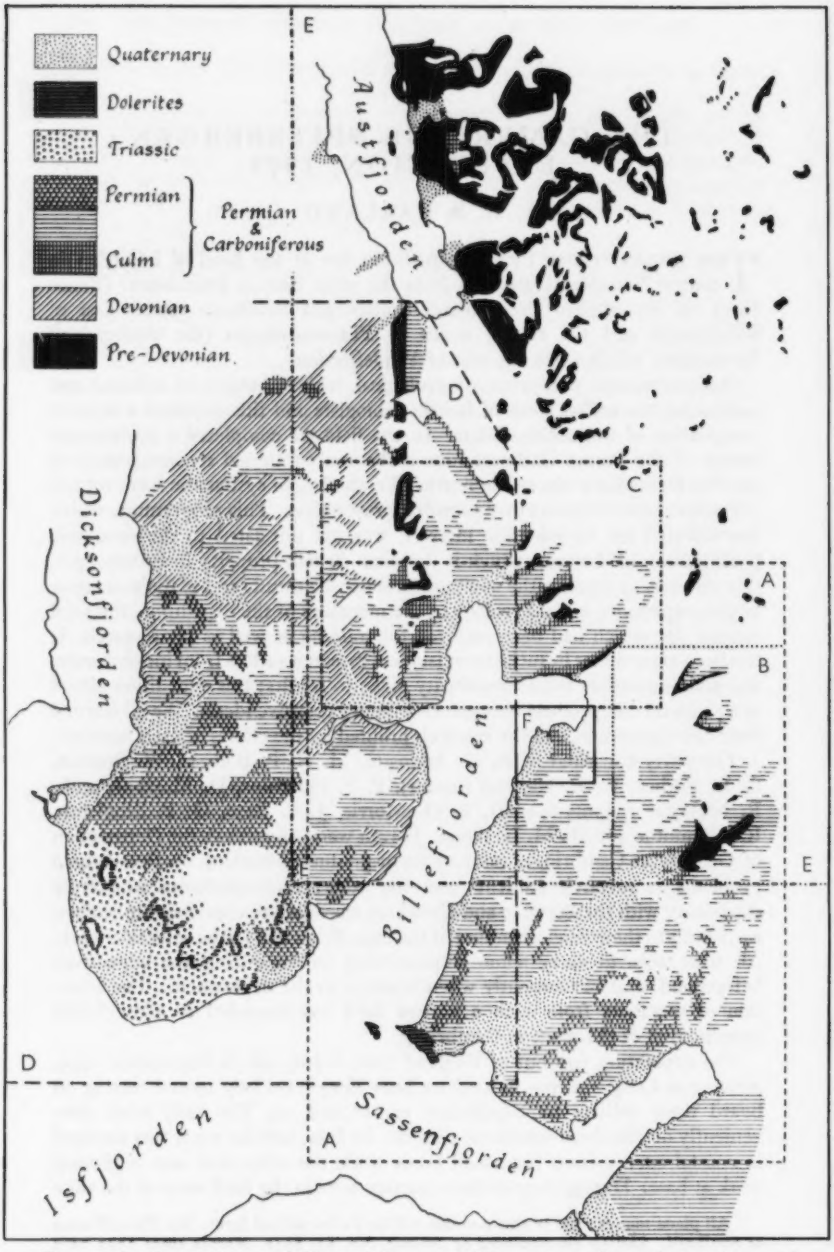


Fig. 1. Geology of central Vestspitsbergen[1] *(See note at foot of opposite page)*

and two men worked at base; the eastern Survey operated from a tent on Nordenskiöldbreen, south of Ferrierfjellet, the Ebba Survey from the hut at Ebbadalen, while the third party sledged from Ebbadalen to the north. In September work continued within easy reach of Brucebyen.

The geological work

The main outlines of the geology of Spitsbergen are already familiar, and an excellent account has been written by Orvin [1] who has also published an invaluable classified bibliography [2] of the subject. With special reference to the area visited by the expedition, some of us [3] have prepared a general review of previous work to serve as a geological introduction to the various papers presenting our detailed results. Hutchins has made a special study of the history of investigations.[4]

The diagrammatic map (Fig. 1) shows the distribution of the five main groups of rocks which are readily distinguishable. Quarternary rocks comprise marine and beach deposits, alluvium, scree, moraine and the various soils derived from these and modified by frost action. These are the well-known soil polygons which we investigated further in the course of the work conducted from Brucebyen. The beach deposits were not studied. Practically horizontal Mesozoic and Tertiary rocks, largely continental, crop out in the area around Longyearbyen, south of Sassenfjorden, and did not concern us except in so far as dolerite sills intrude older rocks and stand out as bold cliffs from the shingle beaches which predominate elsewhere. Gently inclined Carboniferous and Permian rocks occupy the whole block north of Sassenfjorden and east of Billefjorden, and also outcrop north and west of Billefjorden. The main energies of the expedition, comprising the Coastal, Eastern and Ebba Surveys in addition to work from base, were directed to elucidating the structure and stratigraphy of these rocks. Devonian rocks outcrop only to the west of the area and were mapped but not studied. This work is treated in the account of the Southern Survey which was primarily an Upper Palaeozoic investigation. Pre-Devonian rocks underlie the

[1] "Norges Svalbard-og Ishavs-undersøkelser." *Skrifter*, 78 (1940).

[2] *Ibid.* 89 (1947).

[3] E. R. Gee, W. B. Harland and J. R. H. McWhae, "Geology of Central Vestspitsbergen. I—Review of geology of Spitsbergen with special reference to Central Vestspitsbergen. II—Carboniferous to Lower Permian of Billefjorden." *Trans. Roy. Soc. Edin.* 62 (1951–2) 299–356

[4] *Op. cit.* Part 1, "Section A. History of field work," by P. F. Hutchins. P. F. Hutchins, "British Scientific Work in Spitsbergen," *Endeavour*, 11 (1952) 17–21.

Note.—The sheet boundaries in Fig. 1 are of separate geological maps to be published elsewhere: A—Central Vestspitsbergen (1: 100,000), from a compilation by Gee, Harland and McWhae, including 1949 results. B—Terrierfjellet to Gipsdalen (1: 50,000), from a survey in 1949 directed by Forbes. C—Petuniabukta (1: 50,000), from a survey in 1949 directed by McWhae. D—Dickson Land (1: 50,000), from a survey in 1933 by Brough, Mann and Robertson and a compilation by Robertson from Stensiö and De Geer. E—Southern Ny Friesland (1: 100,000), from a survey of pre-Devonian rocks in 1949, 1951 and earlier. F—Brucebyen and Teltfjellet (1: 5000), a survey of soil polygons in 1938 and 1949.

Sheets A, B, C and D will be published in *Trans. Roy. Soc. Edin.*: sheets E and F are in course of preparation.

Carboniferous rocks around Nordenskiöldbreen and to the north they outcrop in nearly every mountain and cliff which emerges through the ice. It was for the further investigation of these rocks that the Northern Survey was organized. This was expected to be our main task, but it soon became clear that the Southern Survey could achieve decisive results if more opportunity were given, whereas the Northern Survey could not be finished in a single summer. Events have vindicated the decision to complete the Southern Survey and leave the Northern Survey a stage farther on with a most attractive future.[1] In the account of these individual "Surveys" the interchange of personnel between the various parties will be ignored.

The Southern Survey

The Southern Survey was to study the structure and stratigraphy of the Carboniferous and Permian rocks of Billefjorden. Apart from considerable lateral variations and flexures, these rocks lie nearly horizontally and are well exposed in a series of mountain cliffs and bluffs in country deeply dissected by ice. Interest first centred on this area during the scramble for concessions, because of the outcrop of coal in three localities. The early expeditions of Nordenskiöld, de Geer, Nathorst and Conway covered the general region. In 1898 and 1899 Bruce had claimed estates in this area which were taken over by the Scottish Spitsbergen Syndicate in 1909 and again visited by him. In 1919–22 the Syndicate organized large expeditions with a number of geologists whose reports have until recently remained confidential. Their work begins our detailed knowledge of these Permo-Carboniferous rocks. During Binney's expeditions of 1921 and 1923, although they were based on Brucebyen, no systematic work was done on Carboniferous rocks though Segnit collected specimens now in Oxford. On Glen's expedition of 1933, a survey party under Mann, with Brough and Robertson as geologists, investigated Dickson Land.[2] In 1938, in support of McCabe's work, I measured a number of Carboniferous sections in Campbellryggen and collected specimens. After the war, when I was planning further work, the Scottish Spitsbergen Syndicate organized an expedition in 1948 with E. R. Gee as geologist. He and I compared notes before and have collaborated since; the time was ripe for the work of the early Syndicate expeditions to be collated with later unpublished work and, in the process, the outstanding questions of correlation developed into a detailed programme for this part of the 1949 expedition. It was J. R. H. McWhae, a research student at Cambridge, who collated these earlier records and then led the investigations in the field.

The 10,000-ton collier S.S. *Ingeren* arrived at Longyearbyen early on the morning of July 19. Outboard motors and other stores were unpacked, and the coastal party of the Southern Survey set off down Adventfjorden in

[1] It was later the principal objective of one party of the Oxford and Cambridge Spitsbergen Expedition in 1951.

[2] Mann's survey, with the geological boundaries and field notes compiled by Robertson, has recently been lent to us and the results, where not superseded, have been incorporated in the maps in this paper. The geological results have been used by R. McWhae in "Geology of Central Vestspitsbergen, Part III." (MS. 1951). It is hoped to publish their original map as an appendix to this paper.

two 16-foot whale boats (Strandebarmar) bought recently in Norway. McWhae led this party with Atkinson, Forbes, Page, Singleton and Taunton. The two boats, *Faith* and *Hope*, were heavily loaded with food and equipment for about ten days, which made it necessary to land at Deltaneset a few hours later when the wind rose. The remainder of the expedition saw them pitching camp as they passed up the coast with equipment on Hilma Nois' sealer, towing *Charity*, our second-hand 18-foot dory. Leaving the following noon in a choppy sea, *Faith* and *Hope* continued up the coast along Sassenfjorden to Sassendalen and thence across Templefjorden to the north coast by Von Postbreen. Here the geological work began with a survey of the coastal mountains. Vertical sections were measured by climbing mountain slopes, collecting specimens and recording rock types by aneroid readings. The idea of using army telephone wire to measure cliff sections was soon abandoned, but it was used to measure short bases on the shore when the height of key formations was controlled on two occasions by triangulation with an artillery director. Throughout the coastal survey no attempt was made at topographical work as the Norwegian map [1] is quite reliable. Additional detail was however necessary from a stratigraphical point of view, and certain blanks were filled in on a geological traverse from Tempelfjorden to Gipsdalen. McWhae, Page and Taunton made this journey while Atkinson, Forbes and Singleton continued working from the boat along the coast to Gipsvika. Here the Scottish Spitsbergen Syndicate hut was used for a few days as the seas in Sassenfjorden lived up to their reputation and prevented the party continuing by boat. At length Gåsodden, the dolerite point at the entrance of Billefjorden, was rounded and the coastal work continued to Brucebyen; Atkinson and Page having made an overland traverse from Gipsdalen.

In the course of these traverses, lithological horizons were traced round the coast to clarify previous hypothetical correlations. Although the rocks appear to be approximately horizontal, there is a regional dip to the south, complicated by flexures and faults. The most southerly region therefore reveals the highest part of the geological succession, with Permian fossils: most of the later work being in lower beds of Carboniferous age.

The boat party arrived back at Brucebyen on July 30. The clear weather during these ten days had resulted in a successful survey and the camps had been enjoyable, for the coast abounds in driftwood.

The base party had meanwhile sledged a large Icelandic tent up Nordenskiöldbreen to a site on the ice slopes of Urmstonfjellet south of Ferrierfjellet, from which most journeys could be made on ski. On July 30, an advance party began to reconnoitre and build cairns at points for a plane-table triangulation, from Terrierfjellet to upper Gipsdalen, which was begun from a base across the ice between two camps. Fine days were used for surveying, others for stratigraphy. During the last ten days of August, Masson-Smith connected the peaks with those in the Ebba region by theodolite, and Singleton and Morris continued recording the Carboniferous succession in upper Gipsdalen. For more than a month Forbes directed the Eastern Survey from camp Urmston. Page and Brasher later examined the Pre-Devonian of Upper Gipsdalen.

[1] Sindballe, Claim Map No. 14, 1924. (Norsk Polarinstitutt.)

On August 2, McWhae, leading a party of six, began work in the region accessible from Skottehytta, the hut in Ebbadalen previously used as a base by Jackson, Glen and others. Assisted by Atkinson, then Wood, and finally Page, McWhae carried out a plane-table geological survey (mostly below cloud level) traversing along the coast and up the valleys. It was found more efficient to do this work from the hut, where results could be kept up to date, and this also saved the time and energy otherwise spent in making, breaking and carrying subsidiary camps. But it was only by working very long hard days that this was feasible, and most of the work was arduous and unrewarding save in the thoroughness of the resulting survey. The Ebba party was not without its adventures, as when *Hope* was all but lost and was rescued from mid-fjord with a rubber boat.

Masson-Smith began a theodolite triangulation from the Ebba region based on Flemingfjellet [1] (P 4), De Geerfjellet, and Gizehfjellet (P 12). From these stations many other peaks were intersected and although several points had previously been surveyed, probably with considerable accuracy, an independent triangulation was planned using some of the existing cairns. A base was measured across the ice between Sporehögda and the foot of Bastionfjellet. The triangulation was extended to connect with the Eastern Survey by using the newly cairned points and later by occupying Ferrierfjellet. It seemed hopeless when the first week was spent in a mountain tent waiting for the storms to pass; only after we had decided to engage all parties on geological traverses did the weather permit triangulation. Masson-Smith has since plotted the network by which all our separate surveys are connected. Further details of this survey are given in Appendix II.

New topographical and geological maps on a scale of 1 : 25,000 have since been drawn from the Eastern and Ebba surveys by Forbes and McWhae [2] which extend and correct the existing maps and fill in some of the blanks. McWhae and Singleton were primarily responsible for the stratigraphical correlations [3] in the course of which over sixty detailed successions were recorded; those who know the screes of Billefjorden will recognize this as an achievement in itself. McWhae has related many variations in the stratigraphy, which is complicated by gypsum deposits and extensive breccias,[4]

[1] New names proposed by the expedition are shown on the map, and listed in the appendix, without further comment in the text.

[2] Sheets B and C, respectively, in Figure 1.

[3] We have found that the following main subdivision of Carboniferous and Permian rocks best groups the variable formations and conforms so far as possible to earlier usage:

		Thicknesses
Brachiopod Cherts		1065 feet
Cyathophyllum Limestones	Upper Gypsiferous Series	720–950
	Wordiekammen Limestones	760–980
Campbellryggen Group	Passage Beds	0–975
	Lower Gypsiferous Series	0–950
Culm		0–850

The age of these formations will be discussed when all the palaeontological results are available. They range from Lower Carboniferous to Lower Permian.

[4] R. McWhae, "The Carboniferous breccias of Billefjorden, Vestspitsbergen." *Geol. Mag.* (in the Press).

to a history of movements along a major north–south fault belt.[1] Singleton and others made a large collection of Permian and Carboniferous fossils and these, together with mine of 1938, will engage the attention of Forbes for at least three years. The Petrological specimens will be described by Hutchins who has already completed work on the detrital sediments. The specimens were all presented to the Sedgwick Museum and probably include the largest collection of Carboniferous fossils from Spitsbergen. Although this work is sufficiently justified by the description of another Carboniferous-Permian succession, it will also be invaluable in the event of further exploration and exploitation of coal.

The Work at the Base

It is always a temptation to supplement positive work on an expedition with services useful but not vital, and a base camp is regarded with suspicion by any field party. A large expedition does however require a good base for efficient work, and it was the job of the first base party to get the four derelict huts at Brucebyen organized, and later the Ebba hut too. By carrying out repairs left undone since 1938 we were able to repay the loan of the huts by the Scottish Spitsbergen Syndicate.

In spite of its temptation to the mechanically minded, our workshop saved much time in getting parties off properly equipped and Bott spent many hours in the food-store packing rations for the various parties. We lived down the embarassment of having a light railway on an Arctic expedition by relaying part of the line and, as most trips began by boat, the motors, fuel, equipment and food could be conveyed quickly to the shore, saving considerable time and effort in the course of some forty journeys from Base.

Other huts provided space for living and scientific work. Camp gear, though adequate for several field parties, is nevertheless inadequate for a party at base; we lacked large kitchen utensils and hardly deserved to find the discarded dish mop which barely served us to the end.

Whoever was at base was liable to be called on to assist in the transport of stores and this involved running the boats and motors, of which we had seven.[2] Some of the journeys we had anticipated proved unnecessary through the generosity of the Governor and Mining Inspector who arranged various trips on our behalf and saved us considerable time and discomfort.

Mr. G. Aasgaard, Mining Inspector of Svalbard, was registering the Mineral claims renewed by the Scottish Spitsbergen Syndicate expedition in 1948. Morris and Hutchins accompanied the party in Ebbadalen in July and in August Morris went with him to upper Gipsdalen. The help we were able to give personally and with small powered boats was repaid many times by the Mining Inspector's boat *Polarkull*, especially in the final departure from Brucebyen.

For more intensive work in the Brucebyen area, we had taken heavy hand boring apparatus. In spite of Morris' experience in the use of this tool, it was too hard work, for too little return, for this to be an attractive method

[1] R. McWhae, "The major fault zone of Central Vestspitsbergen (MS. 1951).

[2] R. G. Atkinson, "Outboard engines used by the Cambridge Spitsbergen Expedition, 1949," *Polar Record*, 6 (1951) 110–13.

in regions of permafrost. We were chagrined to find similar gear near abandoned drill sites; details were recorded for possible future use.

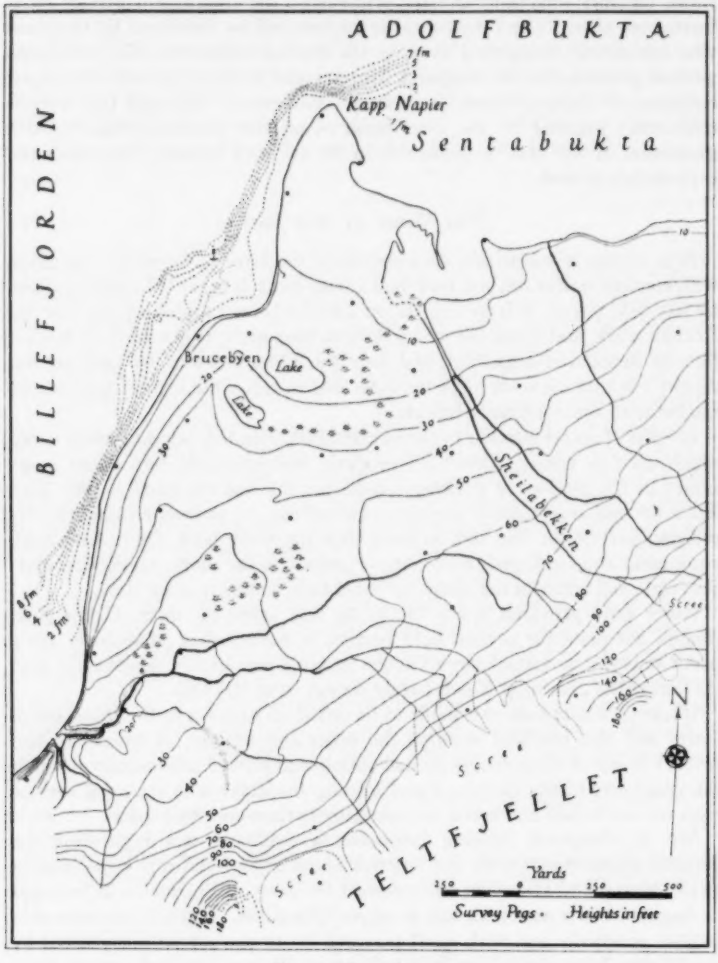


Fig. 2. Brucebyen

Survey

We mapped several square miles of the coastal lowland on a scale of 1 : 2,500 (Fig. 2). About 75 pegs (yellow tops with the letters A to Z, AA to AZ and BA to BM) were fixed, and about half of these were used as plane-table stations for a tachymetric survey of soil types. Heights were determined by alidade and "Quickset" level profiles. The network of pegs is

connected with the principal theodolite triangulation and in turn connects the separate soil, glacier and marine surveys. Timber lasts well in this climate and the pegs should have reference value for many years to come. Masson-Smith was responsible for the work and many others put in one or two days' plane-tabling. What was lost in efficiency and continuity was gained in experience.

Soil polygons

In 1938 we dissected a dozen different types of polygon near Brucebyen and on top of Teltfjellet, and earlier expeditions had made similar observations near the shore.[1] We described and dissected several more and mapped the distribution of many different types for a comparative study. Bott was mainly responsible for the investigation, while Forbes described the botanical aspect of the polygons and organized the recording of soil temperatures. He inserted 38 soil thermometers to different depths in systematic positions in three neighbouring polygons, and readings throughout 48 hours in September (when frosts had returned to sea-level) reveal an orderly pattern of changes throughout the polygons.

Glacier survey

We had hoped to record photographically the various glacier fronts and margins to compare them with earlier photographs. There has not yet been time to make a detailed analysis except for the Nordenskiöldbreen front. Figure 3 shows the glacier front as surveyed by Bott and Masson-Smith in 1949, by theodolite from the cairns Z and AA which were fixed from a base near Brucebyen (at the south-east corner of the south-east hut). Masson-Smith has since plotted this survey together with an approximate front from my 1938 photographs and a more reliable front from the Norsk Polarinstitutt air photographs by B. Luncke in 1936. The 1924 front is taken from the Norwegian claim map of the Scottish Spitsbergen Syndicate estates by Sindballe. The fronts for 1921, 1919 and 1908 are copied from Slater's compilation.[2] Although the lines are of varying reliability, a consistent retreat is apparent. Future comparisons will be simplified by the recent exposure of a new island (Retrettøya) of solid rock in the middle of the front. It is quite clear from our map compilations that the front of Von Postbreen would repay a similar continuation of earlier studies.

Hydrographic survey

The purpose of the hydrographic survey we undertook was to increase our knowledge of shipping facilities near potential coalfields, and to provide a detailed chart. This work received low priority and resulted only in a 1 : 2,500 map of the coast at Brucebyen to a depth of 15 metres. Wood rowed out in line with pairs of survey pegs and Atkinson marked on a plane-table the

[1] A recent paper with references to earlier work is by Gatty, Fleming and Edmonds, *Amer. J. Science*, 240 (1942) 81–92.

[2] Slater, G., "Observations on the Nordenskiöld and neighbouring glaciers of Spitsbergen," *J. Geol.* 33 (1925) 408–46, and Figure 10.

position of each sounding. This large-scale map, related to the survey pegs inland, will provide a basis for comparing the shoreline changes which are proceeding by erosion, or deposition of shingle. The chart, with its 350 soundings along a mile and a half of coast, has been forwarded to various Norwegian and British authorities. It has been generalized in the contours of Figure 2. In September a similar survey of Gipsvika was out of the question, because of the distance and the extensive shallow reefs at a time of

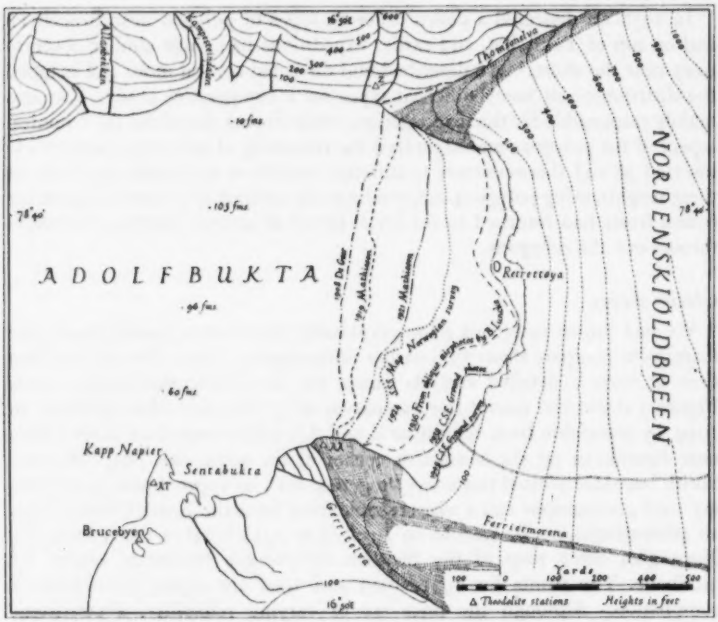


Fig. 3. Stages in the retreat of Nordenskiöldbreen

rapidly worsening seas. The extension of the survey across Adolfbukta is an obvious supplement to the picture of Nordenskiöldbreen in retreat, but there was no time for sounding deeper water with our gear.

Meteorological records

A barograph was used for correcting aneroid traverses up and down mountain exposures of the practically horizontal Carboniferous sequence. Temperature records were also kept at base for comparison with the soil polygon temperatures. Thermometers were used to control a thermograph. Records of precipitation, wind direction, cloud, wet and dry bulb temperatures, etc., were kept, mainly as a further sample of summer weather at Brucebyen. From an inspection of the records the following abstract may be of interest.

Brucebyen (30 feet above M.S.L.)	*July* 23–31	*August*	*Sept.* 1–13
Average temperature	.. 41·5° F.	39° F.	35° F.
Maximum	.. 50°	50°	44·5°
Minimum	.. 38·5°	30°	29°
Precipitation	.. 0	19·7 mm.	11·7 mm.
Clear weather	.. 42 per cent.	16 per cent.	13 per cent.
Overcast weather ..	.. 47	47	52

It was at first intended that the records should be kept at the international observing hours, for comparison with the station at Longyearbyen. The tabulated records have been forwarded to the Norwegian and British authorities, but is not expected that they will be of much use as there could be neither constant nor trained observation.

On a future occasion, unless full meteorological observations are being made, I would recommend the use at each permanent camp of continuously recording barothermographs only (with proper screens), which require weekly attention, supplemented by pocket aneroids and portable thermometers. The mercury barometer, though useful for standardizing aneroids and barographs, hardly justified the frequent observations and the care we took carrying it right way up, from the Air Ministry in London and back again.

The Northern Survey

To the north and west of Billefjorden, crystalline pre-Devonian rocks extend beneath the rolling ice to the formidable mountains of Ny Friesland, and any Devonian and Carboniferous cover has been largely removed. Most geologists on previous university expeditions to Billefjorden have concentrated on this northern region. During the Oxford expeditions of 1921 and 1923 Odell sledged east and north of Nordenskiöldbreen[1] and Jackson's parties collected specimens from Mittag-Lefflerbreen and Finnlandveggen in 1930 and 1932.[2] On Glen's 1933 expedition, Fleming and Edmonds traversed Ny Friesland from north to south, linking up the investigations to east and west of this central route.[3]

Finnlandveggen was again visited by McCabe's party in 1938, when I was fortunate to be the geologist. The structure [4] of the area caught my imagination, and on one traverse up Stubendorffbreen the mists allowed a view of large complex overfolds and thrusts, extending as far as could be seen and clearly revealed in the steep cliffs of Harkerbreen. It seemed that the key to the structure of Finnlandveggen lay in these mountains; the seeds of the 1949 expedition were sown.

[1] N. E. Odell, "Preliminary notes on the geology of eastern parts of Central Spitsbergen," *Q. J. G. S.* 83 (1927) 147–62.

[2] P. E. Fairbairn, "Petrology of the Hecla Hoek formation in Central Spitsbergen." *Geol. Mag.* 70 (1933) 437–54.

[3] W. L. S. Fleming and J. M. Edmonds, "Hecla Hoek rocks of New Friesland." *Geol. Mag.* 78 (1941) 405–28.

[4] W. B. Harland, "Geological notes on the Stubendorff mountains, West Spitsbergen." *Proc. Roy. Soc. Edin.*, Sec. B, 61 (1941) 119–29.

These pre-Devonian metamorphic rocks of uncertain age and complex structure are almost certainly the remains of a great Caledonian mountain chain. They are largely altered sediments, but late granitic intrusions characterize central Ny Friesland. The Hecla Hoek formations, already described [1] from the north-east, form a less altered flank and have been traced westwards, with increasing metamorphism, to the eastern edge of Veteranen. Farther west the "western schists and gneisses," often intensely folded and thrust, may represent the oldest part of the succession (early or late Precambrian) or may be the more altered equivalent of the late Hecla Hoek.

The purpose of the Northern Survey was to consolidate the work of the earlier expeditions by relating and extending the observations of Tyrrell,[1] Odell, Fleming, Edmonds, Fairbairn and myself, and we planned a more detailed study of the structure of the " western schists and gneisses" in the area covered by Jackson's two expeditions. It is not a large area and we did not propose to compete with the sledge journeys of the Oxford expeditions, though longer journeys would be necessary later, after we had gained some knowledge at selected points. It would then be of great interest to connect this part of southern Ny Friesland with the classic work of Kulling [2] and his predecessors in the area of better known Hecla Hoek stratigraphy to the north and north-east.

In 1938 we had closely followed Jackson's 1933 route [3] down Mittag-Lefflerbreen. We were travelling with sledges, but one day's journey brought us to the gaping crevasses on the eastern side of Mittag-Lefflerbreen and it took three hard days to relay supplies for only a short stay to a camp at the foot of Lemströmfjellet. While this is certainly the best route between Ebbabreen and Wijdefjorden,[4] it must have been clear to Jackson that the most economical survey of Finnlandveggen could be carried out by sledge from the interior. I had come to the conclusion independently and, before realizing to what extent we were following again in his footsteps, I had bought the Nansen sledge with which he made the journey in 1932.

Apart from the early journeys, including those of 1921 and 1923 based on Brucebyen and travelling along the southern side of Nordenskiöldbreen, all subsequent sledge routes have been based on Petuniabukta by way of Ebba or Ragnarbreen to the great northern highway of Veteranen (Lomme) Bay Glacier). Our route proved to be a good one, gaining height gradually all the way after the stiff pull from Ebbadalen. It was an unusually cold summer, the surface was good, and we travelled by night to reinforce this advantage.

In addition to the 11-foot Nansen sledge we had a 6-foot boat sledge, lent us for testing. The former proved more efficient with heavy loads on snow, and the latter very handy on glacier ice, because of its easy packing and low

[1] G. W. Tyrrell, "The pre-Devonian Basement Complex of Central Spitsbergen," *Trans. Roy. Soc. Edin.* 53 (1922) 209–29.

[2] O. Kulling, "The Hecla Hoek formation,' *Geogr. Ann.* (Stockholm, 1934),161–254.

[3] R. M. Jackson, "A traverse from Icefjord to Wijde Bay," *Geogr. J.* 78 (1931) 277–83.

[4] A trapper, Hilma Nois, claims to ski the distance from Petuniabukta (Ragnarbreen) to Austfjorden (west side) normally in six hours, in winter.

centre of gravity. A double sledgewheel, designed as a cart to carry the empty sledge along Ebbadalen, mounted two cyclometers, and because it needed no special attachment it could be tied behind either sledge or trailed by hand. It would have been better made of aluminium and with a revolution counter on one of the wheels.

We took three tents, a pyramid, a Whymper and a Mummery, in decreasing order of weight, size and comfort. The Mummery was taken for pack-carrying journeys and was used only at the depot camp.

New styles of sledge box proved both economical and satisfactory for a short expedition. Weight was reduced by packing sixteen man-day rations in light cardboard boxes, which were carried in the boat sledge, the contents being transferred to more substantial fibre boxes for daily use. These fibre boxes (a specially made variety of laundry box) were very light, tough and convenient, with a deep expanding lid which provided a tray for unpacking. The smooth corners were convenient in handling them through the tent openings.

Sledge rations, based largely on those used by McCabe in 1938, were as follows: pemmican, 6 oz.; margarine, 4 oz.; processed cheese, 2 oz.; dried milk, 1 oz.; chocolate (various), 4 oz.; lump sugar, 4 oz.; peaflour, 1 oz.; biscuits, 4 oz.; oats, 2 oz.; dried fruit, 3 oz.; tea, sweets, etc., 1 oz. This ration of 32 ounces was heavy by all sledging standards, but was designed to keep people working happily in the field without long training. It sustained us in heated argument till the end when, exhausted, we agreed that the only improvement would be to replace the peaflour by oats.

We were a party of five, Bott, Brasher, Hutchins, Taunton and myself, but we needed the help of all the others to get our equipment up the steep slopes of Ebbabreen to the depot camp at Sporehögda. We sledged thence up the remaining slope to the snow dome overlooking Wijdefjorden and Billefjorden and stopped for the first round of angles with the artillery director. A base was measured with the wheel and a second round taken at our next camp; undulations in the snow surface are difficult to assess in advance and reconnaissance is really necessary for a good base. However, we fixed subsequent points by resection and did not have to depend on traversing. The second day we crossed the upper reaches of Sedgwickbreen. Beginning in the night we were soon held up in mists and camped for a meal in the chill morning, soon to find a brilliant day awaiting us. We used it to the full in surveying and did not sleep at the camp, as we later pulled up to the slopes above Conwayjøkelen. We crossed this next evening and it was midnight as the five of us pulled the Nansen sledge to Sentralishetta, the highest point on Sentralisen (the central ice dome). The weather and view made this the climax to the expedition. One party skied back for the boat sledge (and got one of the most useful sets of angles, sketches and photographs from this point) while the others established Camp V at the head of Fantastiquebreen.

This camp, not far from Glen's 1933 depot, served as a base from which two parties surveyed for three days. Waynfletefjellet, which we climbed on ski, was our highest and farthest survey station. But the clear weather had gone, and leaving all spare food and gear in the Mummery tent, we cut off

down Harkerbreen, beginning with the disconcerting experience of sledging in thick cloud. During another three days two parties investigated the walls of the glacier and I traversed down the middle doing a compass survey. It was these cliffs which had attracted my attention in 1938, and the circuit was completed at camp VII where this great tributory joins Stubendorffbreen. The ice and water at this corner were a welcome change from dry snow, and relieved the strain on our paraffin.

Before returning eastwards we connected with the 1938 work. Brasher and Taunton continued down the left-hand side of Stubendorffbreen as far as crevasses would allow. The rest crossed Camryggen down Cambreen, with its stagnant northern tributory and its southern part supplied more liberally from the top of Lemströmfjellet, and then across Smutsbreen to the foot of Einsteinfjellet.[1] There is a remarkable alignment of valleys from here up Harkerbreen to Jupiterfjellet. This may once have been the main outlet of Harkerbreen before capture by Stubendorffbreen. It was difficult to resect our position at the end of this straight route with mist-shrouded cliffs.

Time was running out, and with two days' rations in hand we decided to return by a different route to Veteranen and our depot. Clouds were low and hauling up steep slopes seemed a reasonable employment for bad weather until we began to doubt our position in thick mist in the upper reaches of Stubendorffbreen. Brasher and I went up a tributory glacier and confirmed a route to Veteranen; we decided to make the col and camp till the clouds lifted. The slope was steep so all five hitched to the Nansen sledge and were just reaching the brow of the hill when, in various ways, we all experienced a fall of about 40 feet into an ice cavern. We had been spread out, but not sufficiently for this great crevasse, and the Nansen (usually a safeguard) was the last straw which collapsed the roof to make a hole some 15 by 30 feet. The sledge whipped the foremost man back into the hole leaving one ski in place on top (ample testimony to the strength of the thin nylon traces). The snow roof came down with us and broke our fall on a substantial snow bridge. We suffered no injury except for my slightly broken ankle, and no loss apart from Brasher's spectacles and one of Bott's skis which went down another flight. During the next eight hours Bott and Brasher climbed along the crevasse and out through a natural hole and, with ropes from both sledges, hauled up each piece of equipment. After two efforts to haul me up, unsuccessful because I could make no contact with the sides to stop the ropes twisting, Brasher climbed down and helped me out. In the course of those eight hours I was more than relieved to have such experienced mountaineers in the party. No doubt there are many morals to this story. The practical one is to have longer traces when manhauling on snow. Our bad luck was redeemed by good fortune.

After camping on half-rations and repairing the Nansen, we returned by the known route which involved a steep slope down to Camp VII and a long pull up. It took two days to reach Camp V in continuing mist where, with ample food again, we enjoyed a day's rest in a howling blizzard. We were due back on August 29 and with uncertain conditions ahead we decided to leave the remaining survey and devote all efforts to a rapid return. The

[1] We decided to use Smutsbreen as our main base in 1951.

weather improved and we reached Ebbadalen hut after two further days. An hour later McWhae and Page returned. I had only been able to shuffle slowly along on ski, leaving the other four to do all the work involved in hauling two sledges and making and breaking camp. After a rough crossing to Brucebyen and a day's recuperation, four of us went to Longyearbyen in *Charity* on August 31 as previously arranged, to discuss our return transport. Doctor Dalakar ordered me to stay in hospital and with a hot bath and excellent care I was the envy of the others who returned to Brucebyen. McWhae and Brasher visited Bumerangkammen and Ekkoknausane, to complete the northern survey, and Brasher and Page worked on the metamorphic rocks of upper Gipsdalen. Otherwise work continued down the coast and in the neighbourhood of Brucebyen during the last fortnight.

At best, the Northern Survey would have been an exploratory reconnaissance for further expeditions. It now lacked the triangulation planned on the return journey; and it was with the utmost relief that we were able to plot the somewhat random "director" stations and the many intersected points within an accuracy of about 1/250. We hope to publish a further stage in the interpretation of the complex geological structure of this region in due course.

In future I would organize such a journey in two parties from the outset, even if they were to keep together. In clear weather work could have been continued when five of us were often sound asleep; to have the whole party held up by each meal and delay is wasteful. Two such parties, able to go independently or cooperate as necessary, would however require more experienced personnel than we possessed, for I was the only one with previous sledging experience and that was limited to four days.

Acknowledgments

We are indebted to the Air Ministry, the Gino Watkins Fund, West of Scotland Excavations Ltd., the Manager of B.M.B., the Royal Geographical Society and the Department of Geology, Cambridge, for loans of instruments and equipment. We are also grateful for the hire of equipment by the War Office and to Professor Stratton and the Commonwealth Joint Services Committee for arranging this; Miss Hillary, secretary of the Committee, worked valiantly in arranging the loan for testing of certain valuable gear and clothing from the Ministry of Supply. Charles H. Pugh similarly loaned four Atco "boat-impellers" for testing, and his organization has assisted in many ways. Copies of reports on boat-impellers, sledges, carrying frames, tents and clothing have been filed at the Scott Polar Research Institute.

Tobacco, cigarettes and matches were presented by the British & American Tobacco Company and by Bryant and May. Discount was kindly allowed by Robert Lawrie, Joshua Taylor, A. Mackintosh & Sons, Ltd., and the Enfield Box Co. from whom much of our equipment was bought.

There were many occasions between Cambridge and Brucebyen when we regretted the quantity of gear. While each member would plan another expedition more simply, his selection would depend on the experience gained; and that was part of our object.

Mr. Reksten with Jacob Kjøde A/S arranged our free transport on colliers

between Norway and Spitsbergen, taking much trouble to make our way as smooth as it could be. This assistance was not only outstandingly generous but quite necessary to us, as there was no alternative transport. In Spitsbergen we planned to be independent, but at Longyearbyen we were overwhelmed with friendly and generous help. We record our thanks to Mr. Balstad, Sysselmannen, for we realize that notwithstanding the friendliest feelings a British party in transit does little to assist the Norwegians with their own vigorous programme in Spitsbergen.

Generous contributions by the Anglo-Saxon Petroleum Company and the Anglo-Iranian Oil Company, supplemented by research grants from the Royal Society, the Royal Geographical Society and the Gino Watkins Fund, have made the expedition possible. The remaining third of our income is due to each member providing £40 in addition to his own equipment.

The Department of Geology has been the scene of all our activities in Cambridge and I wish to thank Professor King and his staff for so much assistance and forbearance. Our particular thanks go to Miss P. R. Edmiston who acted as secretary to the expedition. The Scott Polar Research Institute provided a constant source of advice and encouragement. Its directors, Mr. Fleming (now Bishop of Portsmouth) and Dr. Bertram, and others there, have advised on matters great and small. We are also grateful for the cooperation of many Norwegian scientists; Dr. Orvin of the Norsk Polarinstitutt helped us throughout. Our time in Spitsbergen was his only respite from queries about photographs, maps and place-names.

Our ambition was fully to use previous records and in turn make our experience and results available. Help from our predecessors was always readily given. Such success as we may claim is also due to the individual members who have assumed that an expedition is the field work of serious research and not purely a long vacation adventure. The demands made in the field were great but perhaps still greater demand has been made on them in Cambridge, and I wish to acknowledge a sustained and continuing cooperative effort.

APPENDIX I

Records

Emphasis was placed throughout on the value of records which alone justified the expedition. Each member had an initial to prefix to his individual series of numbers of stations, specimens, photographs, etc. The member's field notebook was his own property but each was required to enter on to expedition paper all significant records. Stationery was standardized, punched 8-inch by 10-inch sheets; plain, ruled, squared, tracing, "ethulon," etc., and the sheets were sorted and filed in substantial ledger binders—one for each aspect or region. Different members were responsible for the writing of the diaries and reports, and for the care of records and specimens in different departments of work, so that current results were readily available during the expedition. Subsequently this has proved invaluable; for several people have been working on the results and each had ready access to all the records. They now conveniently occupy about three feet of shelf space. The series of folders, with copies of field notes, computations, reports, photographs, correspondence and accounts will be kept in the Department of Geology at Cambridge so long as

this Spitsbergen work continues. We shall then offer them to the Scott Polar Research Institute. The specimens were regarded from the beginning as Sedgwick Museum property.

APPENDIX II

Topographical Survey

Our primary object was to support the stratigraphical work of the expedition with geological maps, and in the process we extended and corrected existing topographical maps. These will be superseded when the Norwegians officially survey this area. The independent Coastal, Eastern, Ebba and Northern Geological Surveys were coordinated by a theodolite triangulation; the hydrographic survey, the Brucebyen survey and that of Nordenskiöldbreen were also coordinated with the same network.

Some of the area in which the expedition worked was already covered by maps of varying accuracy and detail, and by oblique air photographs supplied by the Norsk Polarinstitutt which have proved of the greatest value throughout. This greatly facilitated the preparatory work. Of the existing maps, only the Norwegian claim maps made by Sindballe in 1924 to register the Scottish Spitsbergen Syndicate and other estate boundaries, were found to be reliable. Topographically, the expedition maps are mainly an extension of these. The northern region was not however covered by any reliable map.

The Southern Survey triangulation

The stations occupied for this triangulation were Gizehfjellet (P. 12, built by Jackson in 1930), De Geerfjellet, Flemingfjellet (P. 4) and Ferrierfjellet. The ground stations included Ebbadalen Hut and Brucebyen. The positions of a number of other points were established by the intersection of three or more rays. All the occupied stations are cairned, which made a fair degree of accuracy possible. There is also a cairn on Robertfjellet (rebuilt in 1938) and two more on Minkinfjellet which were fixed by intersection. Those on Minkinfjellet and Ferrierfjellet were built by the expedition. All the cairns are intervisible and stand out well except the one on Flemingfjellet which is obscured by a higher snow peak to the east and by a slightly higher snow peak, Jacksonjellet (P. 3), to the north. Most high peaks in Central Ny Friesland are snow-covered. Cairns built by the French expedition in 1947 were found to the north but did not stand out from our established points. Two bases were measured for the triangulation, one of 10,000 feet running north across the Ebba glacier between Bastionfjellet and Sporehogha, and another of 13,000 feet running across Nordenskiöldbreen from Urmstonfjellet to Terrierfjellet. The ends of these bases were marked temporarily with tents. The bases were measured with the 500 foot Army telephone wire and Abney level readings were taken at every length to correct errors due to slope. It was found that the bases could be measured in this way over uncrevassed ice at the rate of 5000 feet per hour. We used a 5-inch Watts vernier theodolite. This was not ideal, weighing in all 45 lb., and it was slow to read.

Plane-table surveys

Topographical and geological detail was mapped directly on to plane-table sheets. Telescopic alidades were used in the Eastern Survey, for direct triangulation extending from points established by theodolite, and in the Ebba Survey so far as possible for tachymetric radiation and for traverses along the coastal lowlands, using pegged stations.

A plentiful supply of driftwood was available for survey pegs. These were painted yellow and red. The yellow stood out better but orange would probably have been best. Deep red does not show up well on snow or ice. Six-foot bamboo poles with a flag of red cloth were used as banderoles. Six-inch skewers with tags of red cloth were used as arrows for base measurements; these could not be fixed firmly enough in the ground, but served for temporary markers.

Artillery director triangulation

On the Northern Survey we used an "artillery director" (Mark VII) adapted to a light plane-table tripod. This had the advantage that, with little experience and no adjustments, points could be sighted and horizontal and vertical angles read directly from the micrometer screws as fast as they could be booked. The advantage of a compact, simple and rapid instrument is offset by an accuracy limited to one or two minutes of arc. This instrument proved to be ideal when low temperatures, intermittent visibility and the pressure of geological work all required rapid readings. The absence of cairns and distinctive rock peaks made greater accuracy unnecessary.

On our sledge route, or in the course of separate journeys, we occupied convenient stations where one man sketched a panorama and marked in the horizontal and vertical angles (read by the other) of between 25 and 100 points. A panoramic round of photographs was also taken and geological details, specimen members, etc., were marked on the sketch panorama which itself occupied several pages. Speed was limited by the rate of sketching. We occupied in this way some fifteen stations. Owing to the irregular topography, the routes between stations, measured by sledge-wheel, were usually curved and though available as a rough control were hardly used. Forward and back sights could rarely be taken as the next station was unknown and the last was probably out of sight or indistinguishable.

The resection of some of the stations, distant from known theodolite points, proved difficult at first owing to uncertainties in identification. However, by plotting all the rays from each station on a large sheet of "ethulon" and then superimposing several station sheets, reliable points and misidentifications were rapidly sorted out. About fifty mutually consistent points throughout the area were pricked through the sheets; further points were fixed by intersection of two rays and where these were lacking photographs were used.

Compass triangulation

We used the same system of panoramic sketching, supplemented with compass angles, for detail in a large-scale survey of upper Stubendorffbreen from which no distant point could be seen. A light tripod was used for rounds of prismatic compass angles and photographs, and vertical angles were taken with an Abney level. Readings were possible to 5 or 10 minutes which was adequate for local detail. Five stations were connected by a measured traverse. The first of two skiers trailed a tape and marked each 100 feet by a stroke in the snow with his ski-stick. The stroke was numbered every 1000 feet in case a re-check was necessary. This process was little slower than ordinary travel. (One person alone can pace with some consistency on ski if he watches the tip of one ski against the skin binding of the other as a check against lengthening the pace downhill.)

One advantage of compass triangulation is that the necessary instruments were carried in the course of all geological work, whereas it was unjustifiable to carry a director or plane-table without a definite intention of survey. A further advantage, as an adjunct to geological survey, is that in any case a

panoramic sketch is needed to record geological structures and it takes little time to add the angles whether by compass or director. Provided sufficient rays are taken, with their ultimate plotting in mind, there is a good prospect of an adequate map without ordering the work purely for survey. This prospect is improved by making a traverse where possible to support the triangulation and further by overlapping the work done with the compass and the director.

A definite plan of survey depending on the weather is necessary to justify the use of a theodolite or plane-table. A photo-theodolite is the obvious instrument in this region if a survey party is available.[1]

APPENDIX III

The topographical Map

The folding map accompanying this paper was compiled on a scale of 1 : 50,000 by first plotting the theodolite survey and fitting to these points the Norwegian claim maps (1) covering most of the area readily accessible from the coast. From these maps the network of latitude and longitude has been extended, the Northern, Eastern and Ebba Surveys all being related directly to the same theodolite network. The following additional sources have been used:

Bünsow Land. Pye's 1938 plane-table survey (2) was adjusted by Forbes to fit his Eastern Survey triangulation so far as it extended and a similar adjustment was extrapolated in the south-east corner of his map. The south and east of Bünsow Land not covered by Sindballe or Pye were sketched from the Coastal Survey traverse and checked by Lunke's air photographs. The north-eastern portion of Filchner's 1 : 50,000 map (3) was used only to supplement this as it required considerable stretching. Balchin's beach survey (4) was used for some coastal detail.

Dickson Land. Beyond Sindballe's claim map no. 34 and McWhae's Ebba Survey, Mann's manuscript map was adjusted and fitted.

Ny Friesland. In addition to the director and compass triangulation of the Northern Survey the coastline of Wijdefjorden was taken from the Norwegian Chart 510, which is believed to have been plotted by Luncke from his aerial photographs. Harland's 1938 sketch of Lemstromfjellet (5) was adjusted and fitted, and some detail from the Mittag-Lefflerbreen was taken from Jackson's survey (6). Where the above sources did not cover the map, additional details were fitted in from ground and air photographs within the region (and from Pommier and Vallette (7), checked by air photos at the north-eastern margin).

(1) Sindballe 1927. Boundary maps of areas in Svalbard Nos. 14 and 34, 1 : 50,000. Det Kongelege Departement for Handel, Sjøfart, Industri og Fiske, Oslo.
(2) See *Geogr. J.* 94 (1939) following p. 512.
(3) W. Filchner and Seelheim, 'Quer durch Spitsbergen.' Berlin, 1911.
(4) W. G. V. Balchin, *Geogr. J.* 97 (1941) 364–76 (plate).

[1] These lessons were applied in 1951 by (*a*) a major theodolite triangulation with a levelled air camera on the tripod for the photo-plotting of topographical detail, (*b*) resection on geological traverses using a (foreign make) artillery director which, with compass tripod and levelled camera, weighed only 9 lb. This small weight allowed the advantage of director and compass to be combined.

In 1951 Masson-Smith's theodolite triangulation extended over an area partly shown in the source map (Fig. 1). Computations showed an error consistently less than 1 in 10,000. A preliminary plot of the first few score of points overlapped this map and no serious discrepancy was found between the artillery director (1949) and theodolite (1951) points. The map was therefore not altered but some of the later and more accurate heights of mountain summits in the area north of 78° 55′ were added to it.

(5) W. B. Harland, *Proc. Roy. Soc. Edin.* B. 61 (1941) 119–29 (plate).
(6) R. M. Jackson, *Geogr. J.* 78 (1931) 277–83.
(7) Martin, Pommier and Valette, *Polar Record*, 5 (1946) 195; separate unpublished map, 1 : 200,000, Paris, 1947.

Sindballe's maps have proved to be most reliable and we believe our 1949 surveys come next in reliability.

Place names. All place names used in the text and on the map have been accepted by the Norsk Polarinstitutt and so far as possible the list is complete. For this I wish to acknowledge the very considerable help given by Dr. Orvin both in checking existing names and considering new names proposed by the expedition. Most of these names are adequately described in 'Place names of Svalbard' (*Skrifter*, No. 80) though many are now defined for the first time on a published map. Subsequent research has shown that some features were misidentified in ignorance of prior claims; thus Mt. Sedgwick (1933) = Abeltoppen; Castle Rock (1933) = Citadellet; The Citadel (1933) = Gyldenfjellet; Mt. Manchester (1933) = Kinanderfjellet.

A number of names were omitted in *Skrifter* No. 80 or have been proposed and recognized since its publication in 1942. They are listed below. The date following the name shows the year of the expedition which suggested it; the final form results from discussion with Dr. Orvin.

Astronomfjellet	(1900) = De la Baume (1946)	Jelstrupfjellet	(1946)
Austbotnen	(1938)	Jupiterfjellet	(1949)
Balliolbreen	(1933)	Karnakfjellet	(1949)
Bastionfjellet	(1949) = P.2 (1930)	Kinamurbreen	(1933)
Bleikfjellet	(1949)	Luxorfjellet	(1949) = P.1 (1930)
Bumerangkammen	(1949)	Manchesterbreen	(1933)
Caiusbreen	(1933)	Marsfjellet	(1949)
Cambreen	(1949)	McCabefjellet	(1949) = P. 5 & 6 (1930)
Cambridgebreen	(1933)	Menkaurafjellet	(1949)
Camryggen	(1949)	Myggdalen	?
Chephrenfjellet	(1949)	Nathorstelva	(1933)
Didierfjellet	(1946)	Nordbotnen	(1938)
Eddingtonryggen	(1949)	Odellfjellet	(1933) = W.10 (1930)
Einsteinfjellet	(1949)	Pukkelkammen	(1949)
Ekkoknausane	(1949)	Ragnardalen	(1930)
Eroshetta	(1949)	Raudvatnet	(1933)
Fantastiquebreen	(1933)	Retrettøya	(1949)
Faraofjellet	(1949)	Saetherfjellet	(1933)
Flemingfjellet	(1949) = P.4 (1930)	Salknappen	(1949)
Formidablebreen	(1933)	Saturnfjellet	(1949) = S. 3 (1930)
Framstakken	(1949) = N.1 (1930)	Sedgwickjøkelen	(1949)
Furystakken	(1949) = N.3 (1930)	Sentinelfjellet	(1949)
Gizehfjellet	(1949) = P.12 (1930)	Sentinelknausen	(1933)
Glyfsdalen	(1924?)	Sentralisen	(1949)
Gonvillebreen	(1933)	Sentralishetta	(1949)
Harkerbreen	(1949)	Skotteknausen	(1949)
Heclastakken	(1949) = N.2 (1930)	Smutsbreen	(1949)
Heimenfjellet	(1943?)	Southampton-breen	(1933)
Hoelbreen	(1933?)	Sporehøgda	(1949)
Högdalen	(1944?)		
Jacksonfjellet	(1949) = P.3 (1930)		

Stensiöbreen	(1933)	Venusfjellet	(1949)=Mt. de Lorraine (1946)
Störmerfjellet	(1946)		
Tarantellen	(1949)	Watsontoppen	(1933)
Tredalspasset	(1933)=The Navel (1933)	Waynfletefjellet	(1933)
		Westbyfjellet	(1946)
Uranusfjellet	(1949)=S.4 (1930)	Ålandselva	(1933)

DISCUSSION

Afternoon Meeting, 18 January 1951

Before the paper the CHAIRMAN (Mr. J. M. WORDIE) said: Mr. Harland who is to speak to us this afternoon first visited Spitsbergen in 1938 as a member of a party from Cambridge led by Mr. McCabe. The expedition which he is about to describe was mostly made up of Cambridge geologists, some of whom were learning the game while others were experts.

Mr. Harland then read his paper.

The CHAIRMAN: We must all congratulate Mr. Harland on the excellent planning of the expedition which so ably carried out such ambitious schemes. If I may make a remark now, it is that Mr. Harland was a little too modest. I personally would not agree with him that the expedition was over-organized. It was good to learn that they had adequate boats for their work off-shore. We were without that advantage when I was in Spitsbergen in 1919–20 and had no boats capable of being used in the stormy seas; whatever ventures we made had to be undertaken in small rowing boats. It does not seem to me that Mr. Harland did himself or his party any harm whatsoever by going into all the necessary preparations so carefully beforehand.

It has been very pleasant to see so much of the country again, and in coloured photographs. The encampment at Brucebyen (Bruce City) was put up by the party of which I was a member in 1919; we named the place "Bruce City" because city seemed to be the right name for that type of encampment. It was easy to say "Bruce City" and we thought the phrase covered all that ever was or ever will be at Bruce City. We painted the Union Jack sign on our huts. That was in 1919–20, and Bruce City is still interesting because it is the starting-point of all the university expeditions, which commenced in 1921, from Oxford and Cambridge. It was the visit of the Scottish Spitsbergen Syndicate expeditions in 1919–20 which gave rise to the idea and decided the territory which should be explored by so many later expeditions from the two universities.

Mr. Harland has not said much as to the geological results or the discoveries in regard to surface features. I do not know whether he wishes to add anything on that subject now or whether a member of the party would like to do so? Is Mr. Gee here? He was in Spitsbergen as a geologist in 1948.

Mr. E. R. GEE: Mr. Harland has certainly been over-modest in what he has told us; obviously he had a very big programme to carry out. I would like to ask whether, in connection with the geological structure, he arrived at any definite conclusions regarding the formation of the fiords of the area visited. That is a point of interest both to the geologist and the geographer. In the literature the geologists often state that the fiords of Spitsbergen are the result of block faulting of the Carboniferous and Devonian rocks of the area. On the other hand there appears in many instances to be very little evidence of this faulting along the fiords.

Mr. W. B. HARLAND: None of our conclusions can of course be regarded as

final. It seems to me that many of the structures which were supposed to be faults are proving to be either flexures or land-slips. Mr. McWhae was responsible for most of these investigations; I do not know whether he would wish to add to what I have said?

Mr. R. McWHAE: Unfortunately I can add very little at this stage, other than that many of these features seem to be due largely to what is generally known as "differential erosion." We are still working on the details of the faulting and I cannot add more to what Mr. Harland has said.

Colonel ANDREW CROFT: I congratulate the expedition which was a very big one and seems to have been extremely well-organized, especially as regards equipment of which Mr. Harland said he thought he had too much. I hope the results, preferably to be kept at the Scott Polar Research Institute, will show which equipment can be recommended for future expeditions and which can not.

I was at one time in this area, when Wager and I went on an expedition to North-East Land where Mr. Hartog also spent last summer with the Oxford Expedition. At the end of our expedition, having looked from North-East Land at the beautiful mountains of Spitsbergen, we decided we would go and have a look at them at closer quarters, and that we did.

I do not geologize so I can add no more except to congratulate Mr. Harland again. It is very interesting and satisfactory to know that Oxford and Cambridge parties have visited North-East Land and Spitsbergen in 1949 in the same way that the two universities did after the First World War under the auspices of Mr. Wordie and Mr. (now Sir George) Binney. I hope that that work will continue and blossom out into winter expeditions as well.

Dr. BERTRAM: I would also like to add my congratulations to Mr. Harland and his party. He has done extraordinarily good work. There are two particular points to which I would like to draw your attention. One is that Mr. Harland has carried out, to an excellent extent and with much success, the principle of apprenticeship. It is an admirable system, which he has carried further than almost any other recent British summer expedition, in that besides taking an unusually large party he has gone to a great deal of trouble in training the members of it and in watching for results afterwards. He arranged that every individual had a particular task in which he was interested in the field, and he has seen that the interest is continued in the working out of the results.

Another point is the way in which Mr. Harland has carried forward the art of using outboard motors. He has been able to do that partly because there has been an improvement in their design, and his party seems to have been the first of many from this country engaged in this type of work to make real use of what is now available. I congratulate Mr. Harland both on the apprenticeship and the advances in technique.

Mr. J. M. HARTOG: As a member of the Oxford party last year I would like to thank Mr. Harland for the help and cooperation we had from him, both before he went to Spitsbergen and since he returned. We certainly did not achieve any success with our outboard motors, but I congratulate him on his success with his. I would like to ask whether the Stubendorff glacier was showing any signs of activity? Was there any sign of calving?

Mr. HARLAND: We did not actually get down to the Stubendorff glacier front. Brasher and Taunton went down the slope but found the glacier so deeply crevassed that it was impossible for them to reach the front.

Mr. C. W. BRASHER: The Stubendorff certainly seems to be moving very rapidly indeed over one or two sections; it seemed that it was distinctly split

into two portions and that there was one part coming down Harkerbreen. That was where we experienced the main difficulty. The other side of the glacier was not so active and the central moraine seemed to be creeping over to that side more and more. I fear I cannot enlighten you further.

The CHAIRMAN: As there is no further discussion I invite you all to join with Dr. Bertram and Mr. Hartog and others in thanking Mr. Harland for his description of an excellent and well-organized expedition.

THE "FIRST" VOYAGE OF AMERIGO VESPUCCI IN 1497–8

A. DAVIES

TWO RECENT WORKS by Robert Levillier [1] have brilliantly vindicated the reputation of Vespucci and the authenticity of 'The four voyages,' which was challenged by Magnaghi [2] twenty-five years ago. Levillier has however reasserted that Vespucci coasted the Gulf of Mexico in 1497–8 and rounded Florida to reach Virginia. This must be challenged.

In five letters to his friend Lorenzo de Medici of Florence, between 18 July 1500 and May 1503, Amerigo Vespucci described two voyages made to the Americas in 1499–1500, and in 1501–02. These are amply confirmed by contemporary records. The "second" voyage, in 1499, explored the coasts of South America from 6° S. latitude in Brazil to the vicinity of Cape de la Vela (see Map) just west of the Gulf of Maracaibo in Venezuela, and was made for Spain. The "third" voyage in 1501, for Portugal, coasted from 5° S. latitude around the nose of Brazil to 50° S. in Patagonia. The 1503 letter mentioned that he had made two voyages for Spain to the west before the voyage for Portugal, but gave no details of the first voyage.

In September 1504 Vespucci wrote to Pier Soderini, Governor of Florence, an account of four voyages he had made to the Americas. The "first" voyage was in 1497–8 and the "fourth" voyage in 1503. Apart from this printed letter, no documentary evidence exists to confirm these first and fourth voyages. The account sent to Soderini was reprinted in Italian in 1505 or 1506 with the title of 'The four voyages,' and editions in Latin, German and French circulated in Europe within ten years. The "first" voyage of 1497–8 seemed to claim a landfall in Honduras and to have coasted always to the north-west from there for 870 leagues. This has been interpreted by Fiske and others as the discovery of Central and North America, from Honduras around the Gulf of Mexico as far as Chesapeake Bay. This was one year before Columbus saw the mainland of America in 1498 when he visited Trinidad and part of Venezuela.

It is inconceivable that nothing would be known in Spain of a Spanish voyage by Vespucci in 1497–8 which had first discovered Central and North America; most authorities in the nineteenth century therefore rejected this claim by Vespucci as a lie, put forward by him to further his reputation and

[1] Roberto Levillier, 'America la Bien Llamada,' Buenos Aires 1948; and 'El Nuevo Mundo,' Buenos Aires, 1951. In 'El Nuevo Mundo,' Levillier prints all the letters to Lorenzo and to Soderini in Italian, Spanish and English.

[2] Alberto Magnaghi, 'Amerigo Vespucci,' Rome, 1925.

career. Las Casas, Navarrete, Humboldt, Washington Irving and Markham all considered that no such voyage was made and that Vespucci used material from his 1499 voyage in his claim to have discovered the mainland in 1497. Magnaghi in 1925 tried to rescue Vespucci's reputation by arguing that the 1503 and 1504 letters were not written by Vespucci, and that their style, contents, lewdness, omissions and errors indicate they were composed by some different person. Pohl [1] repeated these views in 1944. Revelli [2] in 1926, and Levillier in 1951, have however established beyond question the Vespuccian origin of 'The four voyages.'

Varnhagen first asserted, in 1858, that Vespucci had coasted from Honduras to Virginia. Fiske [3] advanced this view most strongly in 1892 and it was accepted, with some reserve and minor modification, by Harisse [4] in 1892 and by Vignaud [5] in 1917. Finally Levillier in 1948 and 1951 added his authority to the view that Vespucci had discovered North America and the Gulf coasts in 1497–8. Fiske, Harisse, Vignaud and Levillier have swung the weight of opinion to this interpretation during the past sixty years. Nevertheless this interpretation is completely mistaken; it results from a misunderstanding of the geographical evidence in Vespucci's "first" voyage.

Three powerful arguments support the case presented by Levillier.

1. While there are errors, minor omissions and confusions in accounts of all the voyages, and in all the letters, there is nothing to suggest deliberate falsehood in any of them. The accounts of the 1499 and 1501 voyages written to Soderini correspond in essentials with those written to Lorenzo. Apart from the absence of confirmatory records, there is no reason to doubt the account of the "first" voyage any more than of the second and third voyages which are fully confirmed. The incidents and details of native life, customs and organization in the account of the "first" voyage are entirely consistent with those of the second and third voyages and certainly could not be invented or faked.

2. Vespucci's description and claims for the "first" voyage were never disputed in Spain during his lifetime, and he held the envied position of Pilot-Major from 1508 until his death in 1512. It is at least as unlikely that a false claim by him to have discovered Central and North America in 1497 would have escaped comment as that a genuine discovery by him in that year could have escaped notice in Spanish or other records. (This is the paradox of the controversy between the rival views which must be resolved.)

3. The evidence of early maps of the Americas confirms the discovery of coasts from Virginia to Honduras before 1500, although, officially, these coasts were not discovered until later than 1500. Darien was coasted by Bastidas by 1502; Honduras by Columbus by 1504; Yucatan by Hernandez de Cordoba in 1517; Florida and the Gulf coasts by Pinedo in 1517; the coast of Mexico in 1519 and the Atlantic coasts of Florida and Virginia by 1524 under Estevam Gomez, a renegade Portuguese pilot in the service of Spain. Yet in 1500 the Juan de la Cosa Map showed a continuous mainland from South America around the Gulf of Mexico to Labrador. To be sure the coastal outlines are so hypothetical as to represent an idea rather than an actual coast which had been explored. But the Cantino Map of 1502 showed unmistakably the coasts from Cape Hatteras around Florida to the Gulf. The Canerio Map of 1502 showed

[1] F. J. Pohl, 'Amerigo Vespucci, Pilot Major,' New York, 1944.
[2] Paolo Revelli, 'Terra d'America e archivi d'Italia,' Milan 1926.
[3] John Fiske, 'The discovery of America,' Boston, 1892.
[4] Henry Harisse, 'The Discovery of North America,' London, 1892.
[5] Henri Vignaud, 'Américic Vespuce, sa biographie, sa vie,' Paris, 1917.

these same coasts continued around the Gulf of Mexico to Honduras, and the Waldseemuller Map of 1507 continued the Canerio coasts to link them with South America. Clearly marked on these last two maps are Florida, Yucatan and the Gulf of Mexico. There are no records of any voyages other than that of Vespucci in 1497–8 to account for these maps, and Fiske, Harisse, Vignaud and Levillier consider them to be confirmations of their view that Vespucci explored these lands.

The first and second arguments can be accepted without question, but the map evidence gives no support for Vespucci. The coasts shown on these maps of Cantino, Canerio and Waldseemuller are reasonably good representations of the American mainland for their day, but the vague and ill-defined geographical outlines of the "first" voyage cannot be reconciled in any way with these coasts. The sum total of Vespucci's description of the coasts he visited and the route of his 1497–8 voyage can be briefly stated, for the greater part of his letters describes the Indians, their life and customs, and incidents of the coastal voyage.

"Here we anchored our ships . . . and we sailed north-west, for thus the coast trended, ever in sight of land . . . we went constantly skirting the coast. This land is within the Torrid Zone, enclosed within the parallel of the Tropic of Cancer. . . . We quitted this port (the province is called Parias) [1] and sailed along the coast, ever in sight of land, until we had sailed past 870 leagues of it, ever to the north-west, making many stops along it. . . . We had been thirteen months on the voyage and the ships were much consumed and leaking. . . . And having repaired our ships we sailed for seven days, out to sea, on a course between north and east . . . to some islands . . . where we took slaves. . . . And we set sail for Spain with 222 slaves . . . and we reached Cadiz where we sold the slaves." [2]

This account of the "first" voyage gives no hint of the peninsulas of Honduras or Yucatan, nor of the great curve to the east and south of the Gulf of Mexico, nor of Florida or the north-east trend of the Atlantic coasts of North America, all of which are clearly shown on the maps cited. It describes a coast stretching 870 leagues to the north-west; if the landfall was Honduras no such coast exists and the voyage would have ended in the Pacific west of California. The only coastline of the Americas which trends continuously to the north-west for more than 200 leagues is from Cape San Roque in Brazil to Cape de la Vela in Colombia, and halfway along it is the Gulf of Paria. The distance is nearer 700 leagues than 870 leagues, but few explorers of the time underestimated their achievements when writing for the public.

Vespucci adds a statement toward the end of his "first" voyage—"This land is within the Torrid Zone. It is very pleasing and fertile, full of huge forests and woods, and it is always green for it never loses its foliage." In the opening section of his second voyage, of 1499, written to Soderini, he states:—"And in forty-four days we came to a new land and we judged it to be continental land, and adjoining that mentioned above (in the first voyage) which is situated within the Torrid Zone and to the southward of the Equator, above which the South

[1] Parias is at 10° N., just south of Trinidad. Since this is mentioned halfway through the voyage, which was always to the north-west, it is clear that the voyage was along the same route as in 1499, from Brazil to Venezuela and Colombia.

[2] Slaves. It should be noted that the 1499–1500 voyage ended by sailing north-east for seven days from about Cape de la Vela to Española, and that 232 slaves were later collected in the Bahamas. These slaves from the Bahamas were sold in Cadiz at the end of the 1499 voyage. Fiske argued that Vespucci in 1497–8 sailed for seven days from Virginia between east and *south* to take slaves from the Bermudas. But the Bermudas had never been inhabited when they were first found and settled by Spain in 1515.

Polar Star has an altitude of five degrees." All told he described the land coasted in 1497–8, on three occasions, as "within the Torrid Zone," which means south of the Tropic of Cancer.

The descriptions of the land coasted in 1497–8 and of the Indians, their customs and equipment and life, are very similar to those of the coasts from Cape San Roque to Colombia along which he is known to have sailed in 1499–1500 and in the early part of the 1501 voyage. Some descriptions are identical.

1. "In a single house we found 600 souls." Given in the "first" voyage and in the 1501 voyage (Lisbon letter of 1502).
2. "When asked why they waged war they could give us no other reason than they did so to avenge the death of their ancestors." Also given in the 1502 Lisbon letter on the 1501 voyage.
3. "I deem their manner of life to be Epicurean." Also in the 1503 letter describing 1501 voyage.
4. "We entered into a harbour where we found a town over the water like Venice." Also in the 1500 letter to Lorenzo describing the 1499 voyage.
5. "The women are far more libidinous than the men; for I refrain out of decency from telling you the trick which they play to satisfy their immoderate lust." The first phrase is given in the 1503 Lorenzo letter[1] but instead of refraining, Vespucci there gives the details of the trick.
6. The 1497 voyage coasted 870 leagues to the north-west. The 1499 voyage coasted "more than 700 leagues to the north-west"; the 1501 voyage coasted more than 150 leagues south-east to round Cape San Roque and Cape Augustin in 8° S. latitude. Taken together these amount to 870 leagues in a north-westerly direction.

The Problem of the "landfall" in Honduras

So far there is little doubt that the details of the "first" voyage of 1497–8 were taken from those noted on the 1499 and the early part of the 1501 voyages. But the problem of the landfall of the "first" voyage, supposedly in 16° N. 75° W., *i.e.* in Honduras, must now be considered. The relevant passage given by Vespucci in the "first" voyage is as follows:—"We sailed for 37 days until we reached a land which we judged to be continental land which extends to 1000 leagues west of the Canary islands beyond the region of habitation, [this land was] within the Torrid Zone, because we found the north pole elevated 16 degrees above the horizon, and 75 degrees west of the Canary Islands." This has been generally interpreted as a landfall in 16° N., and 75° west of the Canaries, which would on a modern map be somewhere in Honduras. Examined carefully it is evident that Vespucci is giving the north-west limit of the continental land he coasted and not the landfall where he commenced his coastal voyage.

The 16° N. is almost identical with the 15° N. (an error of 2½° by Vespucci) which he gave as the terminus of his north-westward voyage of 1499–1500 in the concluding section of his account of the second voyage to Soderini: "for, as I said above, we went beyond the equator, 5 degrees to the south and here we were at 15 degrees north latitude." Juan de la Cosa was with Vespucci in the Punta Gallinas region in 1499 and on his famous world map of 1500 he marked it at 16° N. The Cantino Map of 1502 and the Ruysch Map of 1508 also mark this Cape de la Vela—Punta Gallinas region as 16° N. of the equator.

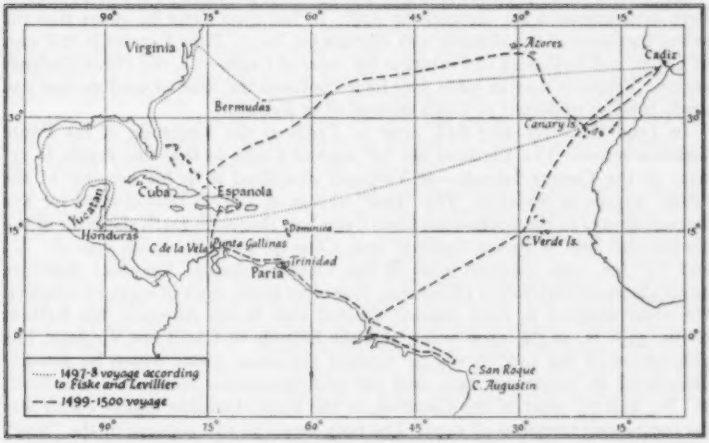
"Continental land which extends 1000 leagues west of the Canary Islands."—Juan de la Cosa, on the second voyage of Columbus in 1493, logged 800 leagues west from the Canaries to Dominica. On his 1500 map he showed Punta

[1] Magnaghi claimed that this 1503 letter to Lorenzo de Medici was also a forgery.

Gallinas as 1000 leagues from the Canaries. Vespucci in this instance was using de la Cosa's experience, and made a close approximation to the distance of the Cape de la Vela from the Canaries. Honduras is more than 1200 leagues west of the Canaries.

"And 75 degrees west of the Canary islands."—On a modern map this indicates Central America; to Vespucci it represented Punta Gallinas. In the 1500 letter describing the 1499 voyage, Vespucci stated that on August 23 he observed the conjunction of the moon with Mars at about 6.30 p.m. whereas his almanac of Monteregius gave this occurrence at Cadiz at midnight of that date. The difference in time of $5\frac{1}{2}$ hours is equal to $82\frac{1}{2}°$ of longitude west of Cadiz, which Vespucci gave as his position on 23 August 1499.

But where had Vespucci reached on the coast of South America by August 23? The 1500 letter stated that his coastal voyage lasted through July and August



into September, and makes it clear that it started from the vicinity of Cape San Roque at 6° S. No further dates are given during July and August.[1] In the concluding paragraph of the 1500 letter, Vespucci stated that his furthest west in the 1499–1500 voyage was 84° west of Cadiz. Since this is known to be Cape de la Vela, the $82\frac{1}{2}°$ of 23 August 1499 should lie $1\frac{1}{2}°$ to the east, in the region from Punta Gallinas to the Gulf of Maracaibo. Possibly they rested at the entrance to the gulf for twenty days (1500 letter) after many Spaniards were wounded in a fight with natives. This location at the entry to Maracaibo on August 23 fits in very well with the general time sequence of the 1499 voyage. The landfall at 4° N. was on June 27 (1504 letter describing second voyage); they coasted during

[1] Magnaghi argued from names of Saints on the maps of Juan de la Cosa, Cantino and Canerio, that Vespucci made his landfall in 4° N. on June 27 (1500 letter) and coasted southward, exploring the Amazon mouth and Para to about 4° S. by July 22. Then he turned north-west and, with winds and current with him, sailed rapidly to reach the coast again at 4° N., at Saint Dominic (August 4 in the Saints calendar). The only other Saint name is San Eufemia (September 17) in the Cape de la Vela region, the terminus of the 1499–1500 voyage. Since Hojeda and La Cosa are known to have arrived in Española on September 5, it is argued that Vespucci named San Eufemia on 17 September 1499. This time-table is reasonable and helpful.

July and August. On August 23 Vespucci was at the Gulf of Maracaibo, 82½° west of Cadiz, where they may have rested twenty days and so arrived at Cape de la Vela, 84° west of Cadiz, on about September 10. Here they rested forty-seven days (1504 letter) and left on about October 27 to reach Antilla or Española seven days later (1500 letter) on November 3. They remained there two months and seventeen days (1504 letter) and left on about 17 January 1500. One may allow one month in the Bahamas, and sixty-seven days to reach the Azores (1500 letter) by about April 17. They returned by way of the Canaries to Cadiz by June 18 (1500 letter), having been thirteen months on the voyage (1500 letter). On 18 July 1500 Vespucci wrote the first letter to Lorenzo de Medici from Seville. The time sequence confirms the probability that on 23 August 1499 Vespucci was near Punta Gallinas and gave his longitude as 82½° west of Cadiz.

On a modern map Punta Gallinas lies 65° west of Cadiz; Vespucci seems to have overestimated the distance by 17½°. In his 1500 letter he states that the prime meridian of the almanac was Ferrara (in Italy). Now Ferrara is 17½° east of Cadiz, and 82½° west of Ferrara is 65° west of Cadiz—*i.e.* the Punta Gallinas region. Vespucci may in some way have confused the time of conjunction and made it to be midnight at Cadiz instead of at Ferrara.[1]

In 1500 Vespucci gave 82½° west of Cadiz as the longitude of the Punta Gallinas region. The Canaries are 7½° west of Cadiz so that this region is 75° west of the Canary Islands—as Vespucci described it in his account of the "first" voyage to Soderini. The "first" voyage of 1497–8 thus coasted for 870 leagues always to the north-west from Cape San Roque to reach the limit of the continental land at Punta Gallinas near Cape de la Vela, which was 16° N., and 75° (or 1000 leagues) west of the Canary Islands. Vespucci therefore never claimed a landfall in Honduras; that error is the work of modern scholars. He never claimed to have coasted Central and North America; his farthest north, 35½° N. in the 1500 letter, was the latitude of Cadiz not Virginia. His description of the 1497–8 voyage covered the same coasts which he actually discovered in 1499 and 1501 and his contemporaries recognized the limit, 16° N., and 75° west of the Canaries, as the Punta Gallinas region which was his north-west terminus of 1499. The only deceit in this account of the "first" voyage was the date, 1497.

Levillier argued that there is no evidence of lying in the "first" voyage and it can be accepted. He argued, equally correctly, that a false claim by Vespucci to have coasted and discovered from Honduras to Virginia would have been challenged in Spain. But there was no such claim, hence no challenge; and, since there was no such claim, there are naturally no records of such discoveries of Central and North America by Vespucci in Spanish records. There are in fact no mysteries and no falsifications by Vespucci in his claims save only the date 1497–8. This was a harmless deception which offended no one in Spain until Las Casas, influenced by the lawsuit between the Spanish Crown and the

[1] Magnaghi (op. cit. p. 151) on Regiomontanus' Almanac. "Johann Muller, called Regiomontanus (of Königsberg), compiled an almanac which was used by Vespucci. He published the *Ephemerides Astronomicae* for each year 1475–1506, which was reprinted many times. Martin Behaim spread its use in the Iberian peninsula and it served Diaz, Columbus and da Gama. The meridian of Ferrara was selected for the prime meridian . . ." Magnaghi also considered that Vespucci failed to allow for the meridian of Cadiz being different from Ferrara. But instead of deducing that Vespucci was at Punta Gallinas on August 23 he thought he was on the coast of Guiana because he assumed that the 1500 letter was in geographic and chronological sequence, which is not the case. (p. 153.)

Columbus family from 1513 onwards, imagined, after the death of Vespucci in 1512, that Vespucci intended claiming priority over Columbus. Levillier has shown that Vespucci never disputed the legal and commercial priority and privileges of Columbus; he could not do so, judging from the patent to Hojeda in 1501.[1]

Caraci [2] stoutly defends the views of Magnaghi and rightly repudiates any possibility that Vespucci made a voyage in 1497–8 to Central and North America. He criticizes the map evidence of Levillier, and repeats the view that 'Mundus Novus' and the 'Lettera' are forgeries with which Vespucci had no connection. In his view they cannot therefore be used as evidence in the Vespucci controversy.

Magnaghi's main argument for insisting that Vespucci did not consent to the publication of the 'Lettera' is that he would never have been made Pilot Major of Spain had he not fully dissociated himself from the claim that he made a voyage around Central and North America in 1497. But the 'Lettera' claimed no such thing; its only fundamental deceit was that it falsified the date of his voyage to 1497–8. Magnaghi noted the bad Italian and the Hispanicisms of the letter to Soderini and argued it was a forgery done in Florence by a friend of Vespucci who had access to the letters he wrote to Lorenzo. But this does not explain the bad Italian, which suggests an Italian who had resided in Spain for some years. Vespucci lived there from 1491–1501.

It is significant that all three documents which declare he made two voyages to the west for the King of Spain were written from 1502 onwards, when Vespucci was in the service of Portugal in Lisbon. To enhance his prestige in Portugal, Vespucci could justifiably claim to have discovered 870 leagues of coast from 6° S. to Cape de la Vela. The date 1497 suggests that in Lisbon he found it necessary to claim that date to establish priority, not over Columbus, but over a Portuguese voyage of 1498 in South American waters. Such a voyage seems to have been made by Duarte Pacheco who, in 1498, was ordered by King Manoel "to explore the west." Vespucci, moreover, claimed to have made this voyage of 1497 in a ship of the King of Castile, thus ensuring his claims could not be overridden by Portugal.

When Vespucci returned to Spanish service in 1504, after the publication of the 'Lettera' in September of that year, his "first" voyage was not criticized by the King of Spain, or by Columbus or Hojeda, because it was evident that it established priority of discovery for the King of Castile in the debatable no man's land of the Amazon (for the meridian of Tordesillas could not be fixed with accuracy). Since Vespucci made no attempt to challenge the legal claims of Columbus it is possible that the 'Lettera' was acceptable to the King of Spain and that it advanced Vespucci in the Spanish service.

[1] J. A. Williamson, 'Voyage of the Cabots,' Argonaut Press, 1929, p. 43, gives the following extract from the patent granted by the Spanish Sovereigns to Alonso de Hojeda on 8 June 1501.

"That you go and follow that coast which you have discovered, which runs east and west, as it appears, because it goes toward the region where it has been learned that the English were making discoveries; and that you go setting up marks with the arms of their Majesties, or with other signs that may be known, in order that it be known that you have discovered that land, so that you may stop the exploration of the English in that direction."

[2] Giuseppe Caraci, "I problemi Vespucciani e i loro recenti studiosi," *Bol. Soc. Geogr. Ital.* 4 (1951).

AGRICULTURE IN ENGLAND AND WALES IN 1801

H. C. K. HENDERSON

ON 1 FEBRUARY 1793 France declared war on Britain and so initiated a period of national emergency which was to last more than twenty years with but a brief respite following the Treaty of Amiens. Towards the close of the eighteenth century the associated rise in the cost of living became of such magnitude that both Houses of Parliament were greatly concerned and their frequent debates led to the setting up of Select Committees, which reported on thirteen occasions during 1800 and the first six months of 1801. Prompted by this same problem, and no doubt stimulated by the activities of Parliament, the Secretary of State for Home Affairs, Lord Pelham, requested the bishops of the twenty-seven dioceses to obtain through the offices of the rector, vicar or curate of each parish a return of the acreage of wheat, barley, oats, potatoes, peas, beans and turnips or rape, and in the northern and western dioceses, of rye also. Forms, of which Table 1 is an example, were printed and sent to the bishops for distribution to their clergy, some of whom gave information of very varied sorts in the "general remarks" column. Among these remarks there are numerous references to the years of 1799 and 1800 as "Famine Years" in which yields were only one-half to one-third the normal. This alone must have been responsible for very high prices for grain by the early part of 1801, when wheat averaged 119*s* against a pre-war average of 47*s* per quarter. Some measure of the urgency with which the Archbishop of York viewed the request can be obtained from the fact that he passed it on to his clergy on September 5, for Lord Pelham must have issued his letter to the Archbishop at some date in August as he was not sworn in as Secretary of State until 30 July 1801.

Table 1

Parish of *Mitton* in the Diocese of *York*

	Number of Acres	General Remarks
Wheat	*85*	*The face of this country is of late very much altered by draining the lands. The Wheat Lands used to lie Fallow every third year according to the old mode of husbandry: but we are now getting into a succession of crops without suffering such lands to lie in this unproductive state by clovers, potatoes and a few turnips. So that on the whole this parish is in a progressive state of improvement.*
Barley	*10–3*	
Oats	*586–1*	
Potatoes ..	*19–1*	
Peas	*0–0*	
Beans	*51–0*	
Turnips or Rape	*6–2*	
Rye	*0–0*	
		April 16th, 1802. *Thos. Armistead Vicar of Mitton, Craven, Yorkshire.*

The forms, referring to the crops of 1801 and completed in October or November 1801, are filed in the Public Record Office among Home Office

papers (H.O.67) and by dioceses (/1, etc). Only one diocese, Peterborough, is completely unrepresented, but the existence in the files of covering letters from parsons for whose parishes no returns exist suggests that some of the records have been lost, e.g. Lewisham. The surviving records have been extracted for

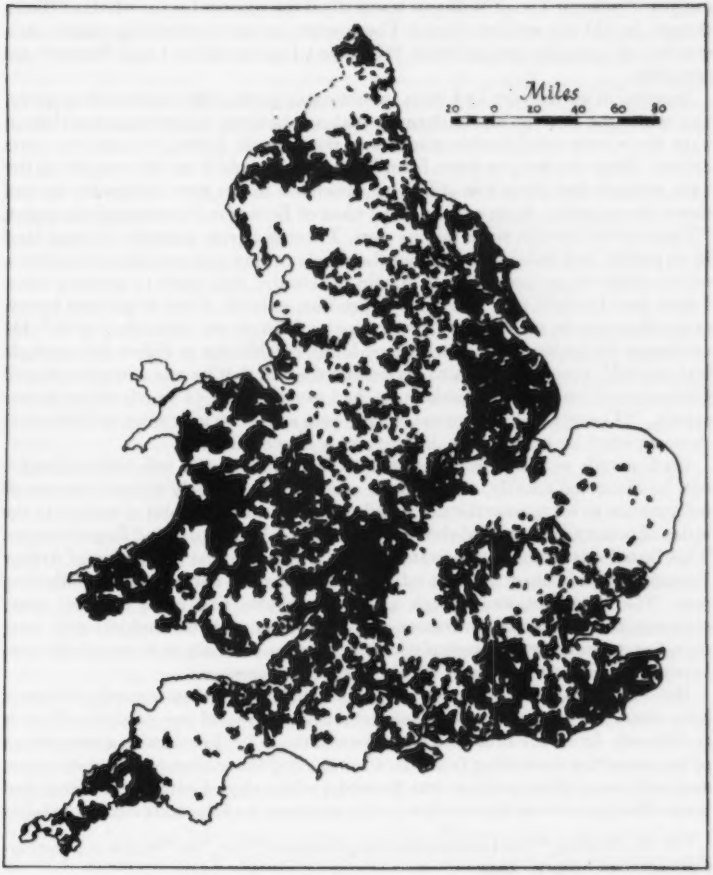


Fig. 1. Areas for which the 1801 returns are available

the twenty-six dioceses available, and Figure 1 shows the parishes in England and Wales for which statistics can be found. It will be seen that certain counties such as Oxford, Devon, Dorset, Westmorland, Norfolk, Suffolk and Nottingham have but meagre records; the last rather surprisingly, as it was in the diocese of Lincoln within which Lincolnshire, Buckinghamshire, Bedfordshire and Leicestershire are well covered. The Welsh dioceses all have fairly

complete records with the exception of Bangor. The West Midlands, including the lower Severn, are particularly well represented.

It is remarkable that so few workers seem to have known or to have used these records. The first two of a lengthening series of papers appeared in 1949 and were concerned with Leicestershire[1] and Gloucestershire,[2] while in the following year Professor David Williams transcribed the records for the whole of Wales though he did not analyse them.[3] The present writer is preparing papers on a number of counties and of these Wiltshire,[4] Leicestershire [5] and Sussex [6] are complete.

Interest in agriculture had been considerable during the eighteenth century, and while the new turnip husbandry had not become widespread until about 1750 there were considerable acreages of that crop in Suffolk twenty-five years earlier. None the less, we learn from Arthur Young and from the remarks in the 1801 records that there was still some resistance to the new husbandry up and down the country. As an example, the vicar of Burton in Pembrokeshire writes, "There are no turnips sown but my own. There is a great quantity of waste land in ye parish, and indeed throughout the whole county and ye adjacent counties, which might be reclaimed by ye turnip husbandry and made to produce corn. I have now brought near 200 acres to produce as large, if not larger and better, crops than any in ye neighbourhood, and ye farmers are astonished at it." He continues by saying he tried to persuade his neighbours to follow his example but was told it would ruin them, as despite the fact that he was a magistrate and Chairman of the Quarter Sessions, he had as much as £50 worth stolen in one season. "Turnips stolen from me, which were sold at ye near town of Milford at three a penny by people who did not sow a single turnip."

Such details as this in association with the statistics, the reliability of which will be discussed shortly, render these records an extremely valuable source of information to set against the necessarily impressionistic reports of writers in the series of county reports published by the Board of Agriculture and Improvement. This Board was established privately in 1793, mainly at the instigation of Arthur Young, and published the first editions of its county surveys in the following year. The later editions, though more voluminous and more detailed, were similarly the outcome of traverses and interviews with landholders and were therefore essentially impressionistic. There is no evidence that any of the surveyors had access to, or knew of, the 1801 crop acreages.

Before going further we must assess the reliability of these records. Farmers have always been reticent and their reluctance to reveal any of their affairs is traditional. In earlier times the payment of tithe in kind had led to a resentment of any inquiries emanating from the Church, and the understatement of crops, as a mild form of tax evasion, was the order of the day. Further, the clergy had been called upon from time to time as tax assessors, and the additional possibility

[1] W. G. Hoskins, "The Leicestershire crop returns of 1801," in 'Studies in Leicestershire agrarian history,' 1949.

[2] W. E. Minchinton, "Agriculture in Gloucestershire during the Napoleonic wars," *Trans. Bristol and Glouc. Archaeol. Soc.*, 68 (1949) 165–183.

[3] D. Williams, "The acreage returns of 1801 for Wales," *Bull. Board of Celtic Studies*, 14 (1950–1), 54–68 and 139–154.

[4] H. C. K. Henderson, "The 1801 crop returns for Wiltshire," *Wilts. Archaeol. and Nat. Hist. Mag.*, 54 (1951) 85–91.

[5] H. C. K. Henderson, "The 1801 crop returns: geographical distributions," *Trans. Leics. Archaeol. Soc.* 27 (1951) 100–102.

[6] H. C. K. Henderson, "The 1801 crop returns for Sussex," *Sussex Archaeol. Coll.* (in the press).

of a new tax strengthened the reluctance to supply the required information. Hence a number of returns bear no statistics, a remark being inserted to the effect that farmers would not supply the information. In some cases the returns given are "believed to be smaller than the truth," as in Table 2. Occasionally the clergyman, fired by the rebuffs he received, walked the parish and made his own estimates. The rector of Bishopstrow near Warminster in Wiltshire made a return but added "Farmers seem very unwilling to give a true account, being apprehensive their crops are to be heavily taxed. With repeated solicitations I obtained the enclosed. The number of acres in the parish 400/500, of which owing to Manorial Rights, Claims and Privileges a fourth is annually uncultivated to the detriment of agriculture and the inconvenience of W. Williams, Rector."

Table 2

Parish of *Addle* [1] in the Diocese of *York*

	Number of Acres	General Remarks
Wheat	411	*The annexed statement must, by no means, be considered as correct—as the farmers, in general, were shy and suspicious in giving in any account of their crops—One thing however may be relied upon, that the statement is much under, and not above the real quantity of acres.*
Barley	442	
Oats	787	
Potatoes ..	99	
Peas	17	
Beans	94	
Turnips or Rape	168	
Rye	9	*H. Nicholson, Rector*
		Addle—Nov. 30, 1801

Occasionally, it is stated that the acres are customary acres, the size of which varies according to locality. The return for Pennington (Lancashire) is stated to be in acres based on 6½ yards to the perch while in Cheshire the perch customarily measured 8 yards. These variations necessitate a number of adjustments before mapping can be contemplated.[2]

Turning to the nature of information in the "Remarks" we find a considerable range of topics commented upon, including straightforward grumbles about the remuneration of the clergy. More interesting are the comments for and against enclosures. In general, parishes with " common " acreages were deemed to be capable of improvement if enclosed, though some clergymen appealed for a general Act of Parliament to enclose all common lands as the expense of an individual Act was "too heavy for this parish". Waste or "commonable" land in Wick (Worcestershire) was estimated at about 250 acres and to be improvable if enclosed. Similarly Finchley (Middlesex) was possessed of about 600 acres of common land bearing only "bad sheep and unprofitable ponies", and an appeal for enclosure was appended. Kirkbride (Cumberland) had "a thousand acres of waste lands which, if enclosed would produce capital corn, etc."

On the other hand, Tingwick (Buckinghamshire) was enclosed in 1773–4 since when the "wheat acreage has diminished by one-third," and at Lidlington

[1] The modern spelling is Adel.

[2] Other examples of unusual units are: 5 roods to the acre, 3 roods to the acre, 18 feet to the chain, 7 yards to the pole, 8 yards to the rod and 6 yards to the perch.

(Bedfordshire) many acres of arable land were converted to grass soon after the Enclosure Act of 1775. The vicar of Deane (Bedfordshire) remarks that "the parish was recently enclosed so grain will decrease as in most parishes." Yet in the same county, at Campton, 900 acres were enclosed in 1797 and "no land has been laid down to grass in consequence." The parish of Hitcham (Buckinghamshire) had been enclosed for twenty years during which "arable has steadily increased, particularly since Lord Granville came," but in Hoggeston a fellow peer, the Earl of Chesterfield, had "laid down all but these 137 acres to grass for dairying." In contrast to the writings of those interested in agriculture at the end of the eighteenth century, there is little reference to hardship among the farm workers resulting from the enclosure of common land. In these records, most of the references to hardship are related to high prices due to the two successive famine years of 1799 and 1800, and to the cornering of grain by dealers in order to maintain the high prices.

In the circumstances it is natural that the recorders stressed bread cereals. Sir W. Ashley, in "The bread of our forefathers," reveals that in the middle of the eighteenth century bread implied wheat only in the south-east of the country, and in these returns there are numerous references to the importance of oats in the north and of barley in South Wales. In St. Michael upon Wyre (Lancashire) we are told "Oatbread and Potatoes furnish the chief part of the subsistence of the poor and middle classes." At Long Preston in the Craven district of Yorkshire "Oats in thin broad cakes are used for bread" while at Burley in the West Riding, "Oaten meal is the common bread—wheat being used only by the first class" and in the parish of Bolsterstone and Midhope "All the inhabitants live entirely on oat bread—no wheat is used except for pies and puddings." The vicar of Greystoke (Cumberland) gives more details and remarks rather tersely "Oat bread—barley for family malt and some bread—wheat used only at Festive Meetings." We learn that barley was the bread grain at Cileau Ayron and Llanerchaeron (Cardigan) while the remarks on the return for Port Eynon in the Gower Peninsula reveal that "Barley bread is commonly used, the wheat carried to Swansea market, 15 miles away."

Returns were requested for rye in some dioceses but few references are made to its use for bread except in Durham, though it appears that "meslin" or "muncorn," a mixture of wheat and rye, was grown and used in many parts of the north of England. The vicar of Stanhope implies the use of rye for bread in the remark that "the bulk of the inhabitants of this parish are supplied at all times with foreign rye and frequently with other grain, from the Port of Newcastle." The small acreages of rye might well be explained by the remarks on the return for St. Helens, Auckland—"Clean rye is seldom used, rye bread is windy and too opening unless for sedentary and old people of costive and dry constitutions."

Of other crops, there are frequent comments on the sowing of peas and beans together rather than separately, and occasionally mention is made of vetch. The reference to turnips quoted earlier is one of many, most of which are on the returns of parishes where common fields persisted and the farming system was two crops and a fallow. In Lincoln, and in the eastern counties generally, the turnip acreage was appreciable in most parishes. Potatoes were grown mainly in cottage gardens and the clergy confined their attention to field cultivations, with the result that the figures are generally small. Large acreages are returned for a few Lincolnshire and Lancashire parishes. Hay is often mentioned as a crop, especially in Pembroke, Cheshire and the northern counties. Emphasis on the decline of arable cultivation in favour of grass for hay is made in many

parishes affected by the growing industrial revolution and the need for local milk supplies, and in coal mining areas such as southern Pembroke where considerable numbers of draught cattle needed feeding. The curate of St. Issels (Pembroke) remarks "As there are Collieries in this parish, the lands are chiefly for grazing the teams of cattle that convey the coal to the shore, by means of which there is less corn."

In most dioceses a proportion of the returns show estimated yields, especially of the cereals. These are expressed in a number of units—we realize the implication of tons of turnips per acre, but a yield of "about 18 sheep per acre all winter" is difficult to equate. It is possible to deal with a mixture of quarters, bushels, bushels of 9 gallons, sacks of 4 bushels, or Cornish bushels of 3 Winchester bushels. Some searching reveals the equivalent of "strikes" (at 8 to 1 quarter), "thraines" (2 bushels) and "bolls" (6 bushels). But such yields as "10 stooks of 12 sheaves of wheat per quarter" or "3 pecks of wheat from 12 sheaves" are impossible to reduce to a standard. To discuss the detailed implications of these estimates would occupy too much space, but one can briefly state that wheat yields appear to have averaged between 24 and 32 bushels per acre in the south-east and between 10 and 16 bushels to the acre in Wales. Barley yields were usually somewhat higher, while oats are recorded as giving as much as 40 bushels in some cases and the exceptionally high figure of 48 for Dalby-on-the-Wolds (Leicestershire). Average yields would appear to be below those of today, especially if one is reminded that 1801 was a good year and that in many parishes the crop was reputed to be as great as those of 1799 and 1800 together. Potato yields varied widely but averaged 150 to 200 bushels per acre, the lower figure being applicable to western and northern parishes.

It is evident that these records are of interest to the economic historian and the local historian. To the geographer, the interest is perhaps more limited, in that their incompleteness prevents the preparation of national maps, crop by crop, and often renders even county maps impossible; but it is suggested that for a fairly representative set of counties the figures are sufficiently complete to warrant our attention. We are then faced with the problems of mapping statistics for discontinuous areas and of indicating the parishes for which no returns are available.

The accompanying map of Herefordshire (Fig. 2) is an attempt to show the distribution and the relative importance of the three main cereals. The three columns represent, true to the scale of the map, the acreages of wheat, barley and oats; the parishes for which there are no graphs are those for which no returns are to be found. The method should give a useful indication of the farming economy of the several areas. It should also enable the geographer to test, against this historical evidence, the validity of the regional distinctions he recognizes in the light of modern distributions.

Within Herefordshire several regional types are discernible. In the south, the graphs show a very similar acreage of wheat and barley but very little oats. This is the area designated "the Ross Region" in the Land Utilization Survey [1] and is coincident with the area of sandy soils mapped by Duncumb in 1805.[2] In the south-west, on the flanks of the Black Mountains and in the Golden Vale, oats becomes increasingly important but the barley acreage is less in comparison with wheat. The central region of mixed farming is characterized by a marked predominance of wheat, a small acreage of barley, and little or no oats; this is the area of glacial soils deposited in the form of moraines by ice moving eastward

[1] 'The land of Britain: Part 64, Herefordshire.'

[2] John Duncumb, 'General view of the agriculture of the County of Hereford,' 1805.

from the Welsh hills. In the eastern part of the county wheat is markedly predominant, and where there are measurable quantities of the other cereal oats is usually the more prominent. In the extreme north the soils are derived from the limestones and the calcareous sandstones of the Ludlow beds in the Upper Silurian and there is an associated increase in the importance of both barley and oats, though wheat remains the most important of the three cereals.

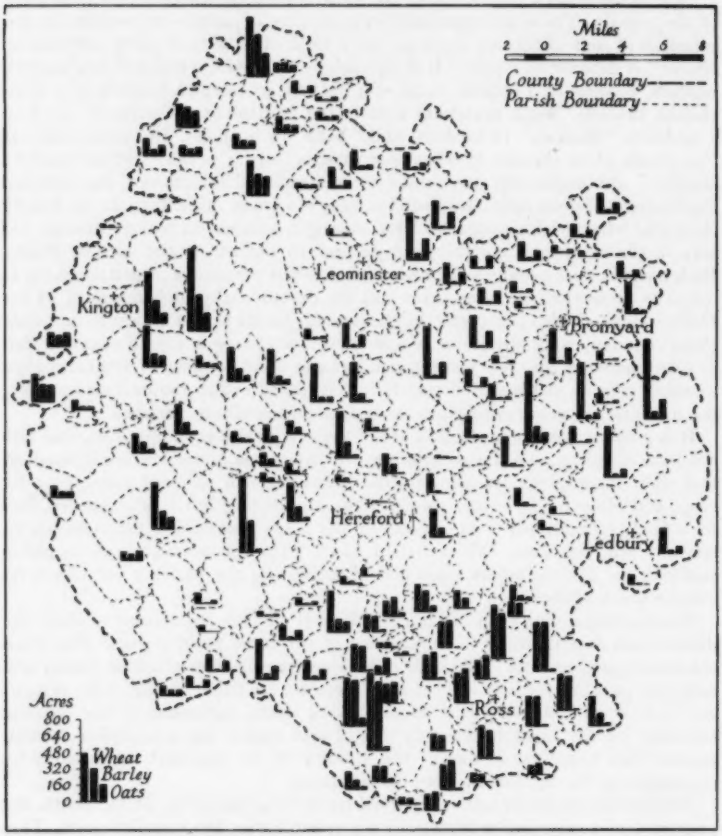


Fig. 2. Cereal crops in Herefordshire, 1801

Of the other recorded crops, potatoes were rarely cultivated as a field crop and in many parishes no return was made, but the remark is often added that potatoes were grown only in cottage gardens. Very few Herefordshire parishes returned any acreage for rye and only one had as much as 20 acres. The introduction of root-crops is not very evident in these returns and the parishes which did have a sizable acreage are scattered over the county, showing no regional distribution. On the other hand peas, or sometimes beans, are recorded in a

large number of parishes which exemplify the local practice of growing a legume between two sowings of wheat. Duncumb [1] quotes as the standard rotation (1) clover ley, (2) wheat, (3) peas or beans, (4) wheat, (5) barley and clover, (6) clover; he adds that sometimes oats or turnips precede the barley, and a few winter vetches are occasionally introduced. In practice, the 1801 returns reveal that the cultivation of the legumes was mainly in the central and the eastern regions of the county, and that peas were much the more popular.

This brief discussion of the distribution in Herefordshire is an example of the work already completed. The writer is at present engaged in preparing similar maps of all those counties for which the 1801 returns are sufficiently complete.

SOME DEFINITIONS IN THE VOCABULARY OF GEOGRAPHY, IV

THE FOURTH LIST of definitions by the British Association Geographical Glossary Committee is of terms in Economics which are of frequent occurrence in geographical works.

Industry. 1. In the widest sense, work performed for economic gain. 2. In a narrower sense, mining, manufacture or handicrafts (as distinct from agriculture, commerce and personal service).[2]

Industries. Groups of firms or plants tending to specialize in the same operations or series of operations.

Primary industry. Activities concerned with collecting or making available materials provided by nature, *e.g.* agriculture, fishing, forestry, hunting, mining.

Secondary industry. Industry which transforms the material provided by primary industry into commodities more directly useful to men, *e.g.* manufacture, construction, energy generation.

Tertiary industry. Industry in the sense of *Industry* (1), other than primary or secondary industries, *e.g.* transport, trade, finance, communications, the professions, administration, personal and other services.

Extractive industry. Those *primary* industries in which non-replaceable materials are removed in their natural state, *e.g.* mining and quarrying.

Manufacture. 1. The making of articles or materials (now usually on a large scale) by physical labour or mechanical power. 2. The working up of material into a form suitable for use. (O.E.D.)

Heavy industry. Loosely used for those secondary industries in which large weights of materials are handled. More precise tests have been suggested based on the following criteria: 1. weight of material per operative; 2. value of a given weight of product; 3. cost of materials as a proportion of gross value of output; 4. proportion of men to total workers employed; 5. horse-power capacity in use per operative.

Light industry. Secondary industries which do not come under the definition of heavy industry.

[1] *Op. cit.*, p. 51.

[2] The *British Census of Production* includes mining and quarrying, manufacturing, building and public utilities, including Government and Local Authorities.

Basic industry. A term variously used in the sense of heavy industry of national economic importance, or of industries fundamental to other industries, *e.g.* sulphuric acid, iron and steel.

Location of industry. The areal distribution of industrial activities.

Localization of industry. The concentration of an industry or a trade in a certain district or districts.

Industrial inertia. The tendency of industries or of firms to remain in a given location or site after the conditions originally determining that location or site have appreciably altered.

Geographical momentum. The tendency of places with established installations and services to maintain or increase their importance after the conditions originally determining their establishment have appreciably altered.

Economy. The whole economic structure and function of a country, region or society. An economy may be described as agricultural, primitive, or industrial according to the activities which preponderate.

Autarky. Economic self-sufficiency as the object of a national policy; to be distinguished from autarchy (=self-government).

Natural resources. Any materials or conditions existing in nature which can be used in economic production in any given circumstances (usually not very different from those obtaining at the time).

Balance of trade. The relation between the total values of a country's exports and imports.

Terms of trade. "The export-price index as a percentage of the import-price index, that is, the amount of other countries' products that a nation gets in exchange for a unit of its own products." [1]

Markets. 1. "Any area over which buyers and sellers are in such close touch with one another that the prices obtainable in one part affect the prices paid in another." (Benham.) 2. More generally, any area in which buyers of particular products are found.

Raw materials. The tangible commodities transformed by a given industry or industrial process into a further product; sometimes loosely used to include the source of energy employed.

Installed capacity. The total potential capacity of a plant or machine, as distinct from the utilized capacity. The percentage relationship between utilized and installed capacity is the capacity factor (or plant factor) when average load is taken.

[1] Hicks, 'The social framework.'

FROM THE *JOURNAL* A HUNDRED YEARS AGO

THE FOLLOWING NOTE on the determination of positions is appended to Mr. (later Sir Francis) Galton's paper on his travels in South West Africa (*Journal of the Royal Geographical Society*, vol 22, page 160). Sir Francis Galton received the Founder's Medal in 1853.

My map is for all practical purposes, and so far as it professes to go, very fairly accurate. I am not aware that any isolated hill is left out, though I do not profess to give the peaks in each group. I should have been involved in endless confusion, had I attempted so much. The limits however of all hills and all groups of hills are taken. I triangulated chiefly with an azimuth compass, from Walfisch Bay onwards as far as there were mountains to triangulate by, that is to Otchikoto on the N., and to Elephant Fountain on the E. I have so great a number of bearings, that I have had no difficulty in making many independent series of triangles, and checking one by the other. I thus pretty easily found out such errors, either of reading off observations, of mistaking hills, or of writing them wrongly down, which I saw in spite of all my care would occasionally occur. I then selected the series of triangles that I thought would give the most trustworthy result, guided by the size of the angles, and more particularly by the definiteness of the mountain peaks that I observed, and then protracted them. Having done this, and registered the longitudes which this triangulation gave for my three main stations, Barmen, Okamabuti and Elephant Fountain (assuming the longitude of Pelican Point, Walfisch Bay, at 14° 27′ 5″, and determining the scale of the map by differences of latitude), I compared these longitudes with those deduced astronomically, and I am glad to say that the agreement is very satisfactory. There is an abstract of all this at the end of the paper. Some grave error had affected my instrument, so that although the observations in each group agree extremely well together, yet there is a wide difference between the longitudes derived from these several groups. I had, however, done my best when taking lunars, say E., to take others W. under as nearly as possible the same circumstances, both of altitudes and of distances, as I could, and of the same bodies also. With sun observations I used one coloured glass, and always the same one, toning the instrument of course as required. I also examined the adjustments of my sextant with all the care I could, previously to beginning to observe; and it is solely from having taken these precautions with great pains that I can account for the excellent agreement of the mean longitudes (deduced as they are from such wide extremes) with that obtained by triangulation. As regards T'ounobis and Ondonga the lunars were taken with a good, though small, and not clearly divided circle, which had to be read off by firelight; still the results of the former are very fair, and those of the latter, being checked by the position of Otchikoto, will answer sufficiently well. I am thus particular upon these matters, as it is of course a satisfactory thing to have well determined the geography of a new country, even though only in outline, for it may save much trouble and doubts to future travellers. I have altogether determined astronomically the longitudes of 6, and the latitudes of 53 stations, and I had no object in taking more.

AN UNDER-NOURISHED WORLD

GEOGRAPHY OF HUNGER. By JOSUÉ DE CASTRO. *London: Victor Gollancz* 1952. 8½×5½ *inches;* 288 *pages.* 18*s.*

THE AUTHOR OF 'Geography of hunger' is a Brazilian, and it is to be feared that in his nursery days he was never told the cautionary story of the shepherd boy who called Wolf! Wolf! The subject of world food-supply is one of great importance to us all, and since Dr. de Castro was Chairman of the Executive of the Food and Agriculture Organization we might expect from him a balanced and well-informed pronouncement. Confronted instead by exaggerations and misstatements that border on the grotesque, the reader is inclined not only to dismiss the book as nonsense but to dismiss also from his mind the very real problems with which it is concerned. Two-thirds of the world's population live in a permanent state of hunger, we are told, and in his foreword Lord Boyd Orr adds for good measure "a recent American Committee put the number as high as 85 per cent." But his scientist's conscience compels him to explain: "The author uses [hunger] in the modern sense as lack of any of the forty or so food constituents needed to maintain health." Does "hunger" in this sense demand to be described in intemperate language? "No corner or scrap of land in Africa has escaped hunger. This is a Continent of the starving, all of it." "In New Guinea . . . eight out of every ten children die before reaching puberty . . . the children are born already wasted by the starvation of their parents." The publisher has thought this second statement sufficiently startling to go on the dust cover, and not every reader, perhaps, will recall the war pictures of Papuans of splendid physique aiding our troops when the Japanese were threatening Australia. Not merely Africa and New Guinea, but the whole Western Hemisphere "is one of the great world areas of hunger and malnutrition," while hungry Asia and "starving Europe" get full consideration. One is reminded of the clever and successful advertisements that convince hearty English men and women that they suffer from "night starvation;" but in the accompanying pictures there is always someone to bring along that warm, milky drink. And how are a mere fifteen to wait upon eighty-five? Or even thirty-three on sixty-six, if that is the ratio of well-fed to hungry?

A question which the layman will ask is this: what evidence have we that the diet which (quite late in history) has become accepted as normal in Western Europe and temperate North America, is in fact the correct one for humanity at large? The nutritionist's measuring stick (and this helps to explain whole continents and whole hemispheres of "want") is the intake of meat, milk, eggs, cheese, fresh fruits and vegetables. But there is a geographical angle to poultry yards, dairy farms and butchers' shops (and a sociological one, too), so that over vast areas the little children never sit down to a breakfast egg, and the milkman never calls. The shocked nutritionist shades these areas black. It is surely a weakness, too, that a fundamental distinction in respect of dietary, that between urban and rural, between the shop-bought and the home-grown, is nowhere made, the more so as locally grown and locally consumed produce (which generally includes the so-called protective foods) escapes the statisticians' net and goes unrecorded. That explains the mystery which not infrequently confronts the nutritional expert, that peoples who by calorie count ought to be dead smile back at him and display their perfect teeth. The Red Indians and the South Sea Islanders knew no milk but their mothers' before western men

discovered them, and granted that there are dietary deficiences (due to habit and prejudices as well as poverty), what is urgently needed is research into the means to remedy them locally, by means of local resources. It is idle to demand a world-wide distribution of dried milk and eggs. Dr. de Castro is however writing to a thesis, and it is this that distorts the picture he presents. Briefly stated it is this: Hunger is not due to over-population, it is the cause of over-population. Feed the hungry myriads with animal proteins (meat, milk, eggs, cheese) and for biological reasons the birth-rate will fall. Apart from some negligible experiments made long ago on rats, the evidence offered for the truth of this paradox takes the form of a table of fourteen countries arranged according to increasing intake of animal proteins, when it is found that they are arranged according to decreasing birth-rate! Such a remarkable correlation (and it is to be regretted that Lord Boyd Orr refers to it as such) demands close examination although here only a general check will be attempted. Some of the figures have to be rejected because the geographical entities to which they refer are not defined. What for the purpose of vital statistics, is "Malay States"? Does "India" mean the pre-partition or the present day Union of India? If the latter, the birth-rate figure is incorrect. Indeed none of the birth-rates can be accepted since there is no indication of the year or period to which they refer, nor is it stated whether they are "crude" rates or rates adjusted to age structure. If we look at the official figures (crude) for the United States, we find that there are remarkable divergencies between year and year; between, say, the 16·6 of 1933 and the 25·8 of 1947, a figure which fell to 24·1 in 1949. What then does the 17·9 of Dr. de Castro's table mean? Again there may be striking divergencies of rate as between social groups within a single State. Recent figures for Canada included 24·0 in British Columbia and 34·4 in New Brunswick for the same year. What would be the significance of a mean figure? Our own country does not appear in the table, but according to a recent announcement of the Registrar General the birth-rate would come very close to that of Sweden, which is here said to be 15·0 and to be matched by the highest intake of animal proteins; and so we in Britain must be far better fed in that respect than the more fertile Americans. But how the figure for this intake (in grams a day) has been arrived at remains a puzzle. Sweden's 62·6 grams (about 2¼ ozs.) is contrasted with Formosa's 4·7 grams. The United States citizen is said to consume 61·4 grams, but on another page it is stated that his per capita consumption of meat alone is 130 lb. annually (over 5 ozs. daily) besides 110 quarts of milk and an unspecified quantity of eggs and cheese. Argentina, consuming 300 lb. of meat yearly, is not put on the list, into which it certainly would not fit! Whatever may be the evidence from these sources, this table cannot support the weight of the categorical assertion: "Hunger is responsible for the over-production of human beings, excessive in number and inferior in quality, who are hurled blindly into the demographic metabolism of the world." Elsewhere through the book it becomes clear that the author is not at home in handling figures, as when he speaks of the Japanese birth-rate as rising to 34 *per cent*, or when he compares crop yields in contradictory terms, or says that the Indian's expectation of life, namely 26 years, is only one-third that of the New Zealander!

He explains quite confidently, however, the cause of all the human misery which he describes. It is "colonial imperialism," which compels whole populations (whether political colonies or not) to produce cheap raw materials for export, instead of producing food. The British, characterized by their "lust for profit," have been the villains in India ever since the days of Clive and Warren Hastings. They destroyed the country's industry, driving the large artisan class back on to the overcrowded land, and although admittedly they brought twenty million

new acres under cultivation by means of irrigation, "this did not affect the food of the people. Its benefits went almost exclusively to cash crops for export." As shown by the rapid rise of population (fecundity bred of hunger) the British brought starvation into Egypt by building the Aswan Dam, and in cooperation with other Western powers "strengthened the hand of starvation in China." Even the United States suffers hunger because it was originally a British Colony—and so on and so on. In Venezuela the story is slightly different. Formerly well fed on meat and corn, the "petroleum dynasty" has changed the people's lot. "To keep the population from starving (we are told) it is necessary to import annually 200,000 tons of meat, 1,000,000 tons of milk, 50,000 tons of cheese, 50,000 of butter, 200,000 of garden crops, 75,000 of rice, 40,000 of corn, 50,000 of legumes, and 60,000 of fats . . . and still the people do not have enough to eat." Yet there are only 4½ million Venezuelans all told, who (according to the reference books) possess 4 million cattle and one million goats, while one-fifth of them are engaged in agriculture. What they do with the imported good things is a mystery, especially as regards the milk, for on another page we are informed that the per capita consumption is only 38 quarts annually, or about 1½ pints a week. And even if they used no home-killed meat at all, they would have more of it than we ourselves. But Dr. de Castro cites over four hundred books and articles in his bibliography, and perhaps did not read them all very thoroughly, so perhaps these imports are wishful thinking.

It is one of the dismal parts of the author's story that the hunger stricken myriads must not be expected to help themselves out of their plight. The Chinese farmer has a tiny farm only because he simply could not cultivate a larger one. The Indian farmer has no energy to move into the tens of millions of acres of arable land in his country still unploughed. The Brazilian sits idle from sheer inanition in the midst of tropical luxuriance. And the remedy? "A better adjustment of men to the lands they occupy," and "a transition from a colonial economy to a cooperative world economy." Under an "economy of abundance" human fertility will rapidly decrease, and so the population problem is solved.

Nevertheless, if we discount Dr. de Castro's attitudes and opinions, and substitute such words as "deficiency," and "malnutrition" for the more sensational ones that he loves to employ, the book is worth reading, for an enormous mass of information has been put together, and since all the author's sources are cited, it is possible to give its due weight to each page as we read. The outlook for the control and elimination of deficiency diseases and hence of the lethargy and poor physique that are among their consequences, is full of hope, and such control is, of course, a necessary first step towards higher productivity. Cretinism was conquered in Switzerland by quite simple means. And the rehabilitation of the Ninety-mile Desert in Australia is a heartening reminder of what science and enterprise in joint partnership can do. Malaria, too, is in retreat at last.

E. G. R. TAYLOR

REVIEWS

EUROPE

PREHISTORIC EUROPE: the economic basis. By J. D. G. CLARK. *London: Methuen, 1952. 11 × 8 inches; xix + 349 pages; maps, diagrams and illustrations. 60s.*

Dr. Grahame Clark is known to a wide circle of readers through his many important publications on British and north European archaeology and in particular for his pioneer work on the Mesolithic period, in which his meticulous scholarship was conspicuously displayed. His new book not only shows the same quality but carries it into a field of wider interest which might be described as the human geography of prehistoric Europe. Dr. Clark would term it economic prehistory, but he is well aware of its geographical basis. More than most prehistorians he sees beyond the classification of artefacts—though his own work has demonstrated its value as a solid basis for further advances—to the men who made them and the environment in which they lived. It is only when account is taken of place, folk and work that a full understanding of the changing scene in prehistoric as in historic times can be obtained.

Dr. Clark is the first to admit the wide gaps in our knowledge of the details of society and environment in the prehistoric phases of European life, and states that his main object is to stimulate research among archaeologists and allied workers. But what will surprise the reader is the volume of the evidence here assembled and carefully weighed. One by one, with exemplary thoroughness, the elements of material culture are examined, annotated, dissected, and abundantly illustrated, providing the student with a mass of evidence on such topics as "Catching and gathering," "Forest-clearing and farming," "Houses and settlements," "Handicrafts," "Trade," and "Travel and transport." Illuminating parallels are drawn from the literature of surviving European folk-cultures.

Essentially this is a source-book for the researcher, bringing together the findings of widely-scattered workers in many regions and sifting them wisely. Dr. Clark is cautious in his inferences and rarely allows himself to draw conclusions which cannot be firmly established. Presumably the omission of any reference to the *callais* beads so often cited as evidence of megalithic trade in south-western Europe is due to uncertainty as to the source of the raw material. On the other hand Dr. Clark's linking up of the soil-exhaustion brought about by the shifting cultivators of Neolithic central Europe and the emergence of warrior cultures bent on commerce, war and domination in the early days of metal is most illuminating. In the section on farming (p. 108) it may be questioned whether the two-field system was always practised "so soon as fixed fields were established"; surviving practice suggests that in north-western Europe some kind of outfield system opened the way to alternating fields.

It is in differentiating the sub-regions of relief, climate, soil and human tradition within the major regions discussed in this book that the geographer can make a useful contribution to economic prehistory. The temperate deciduous forest zone of Figure 2, for example, embraces not only the varied habitats of the British Isles but the continental land mass from northern Spain to the lower Danube and the Gulf of Finland. Dr. Clark makes full use of distribution maps and many a geographer could study with profit the clarity of his cartography and

his well-chosen map symbols. The illustrations maintain a high level and are a most valuable feature of the book; there is also an excellent bibliography. The quality of the printing and the blocks is worthy of the author and his text. This is one of those rare productions to which the epithet "monumental" can be justly applied. E. E. E.

ASIA

GEOLOGY OF THE COLONY OF NORTH BORNEO. By MAX REINHARD and EDUARD WENK. *London: H.M.S.O.*, 1951. 10×7½ *inches;* xiv+160 *pages; diagrams and illustrations; maps in pocket.* 2½ *guineas*

This important book is a compilation of the geological work carried out in British North Borneo (*i.e.* the present "Colony of North Borneo") by early explorers and by professional geologists sent out by universities or employed by private companies prospecting concessions. The contribution of the Royal Dutch–Shell group is outstanding, not only in permitting the authors to use a large number of confidential reports but in preparing the volume for the press. The excellent petrographic and petrochemical investigations were carried out at the University of Basel.

The volume is intended for geologists, and even then mainly of interest to mineralogists and petrologists. Nearly three-quarters of the text is devoted to a meticulous examination of igneous and metamorphic rocks. As for the rest, the first chapter of two pages deals very briefly with topography, climate, vegetation, population and communications; and the second with the history of geological exploration. They are intended to form a background for the purely geological discussion, and for fuller information the geographer would turn to the 'Handbook of the State of North Borneo' (1950) and to other writers.

There are conspicuous blanks on the geological maps, but enough work has been done to make a coherent geological picture. The oldest rocks are crystalline schists and associated intrusives of between pre-Cambrian and Upper Palaezoic age. The mountains they formed were peneplained, and underlie the intensely folded, unfossiliferous Slate Formation and the very strongly disturbed and imbricated Danau Formation. The relationship between these formations is unsolved, but the authors are inclined to consider the Slates as the older and possibly of Upper Palaeozoic to Lower Mesozoic age. In the squeezed and crushed sandy shales and sandstones of the Danau are highly characteristic intercalations of red and variegated radiolarian chert and predominantly basic intrusive and extrusive rocks, the ophiolites. The Danau may be Mesozoic to Paleocene in age.

Above the peneplained pre-Tertiary and Paleocene (?) rocks is a Tertiary sequence probably some 33,000 feet in maximum thickness. They cover 75 per cent. of the territory, and are classified under a fourfold division in van der Vlerk's letter system: Ta–b, Te_1–e_4, Te_5–f (which correspond roughly to Eocene, Oligocene and Miocene) and Plio-Pleistocene. The lowermost division consists of epi-continental deposits and reef limestones. The succeeding ones show marine shallow water, paralic, reef and volcanic facies. The most important orogenic period was between Te_4 and Te_5 times, with magmatic extrusion and intrusion, of which Gunong Kinabalu (13,450 feet) is an outstanding example. A belt of mud-volcanoes in the central east coast area appears to be associated with the formation of the comparatively recent Sulu Sea.

A systematic treatment of geomorphological problems is out of the question, but field geologists have been struck by the eccentric position of the dominant

mountains and ranges with respect to the drainage system and the apparent independence of prominent orography and main watersheds; by the close correlation between relief and rock type; and by the occurrence of Tertiary peneplains. The evidence for relative changes in sea-level is of considerable interest, and offers attractive research problems, particularly in view of the marine terraces in the adjacent territories of Brunei and Sarawak. J. H.-L.

AFRICA

AFRIKA: EUROPAS GEMEINSCHAFTSAUFGABE NR.I. By A. ZISCHKA. *Oldenburg: Gerhard Stalling Verlag*, 1951. 9×5½ *inches;* 340 *pages; maps*

This book is, in a sense, a sequel to 'Asien, Hoffnung einer Neuen Welt' by the same author which appeared in 1950 and was reviewed in the *Journal* (117 (1951) 227–228). In assessing the value of his suggestions regarding further white settlement in Africa it should be borne in mind that Mr. Zischka has nothing but admiration for Italian colonial methods and still believes that a hard-working and peace-loving Germany was drawn into two world wars by the Machiavellian machinations of a far-sighted British diplomacy seeking only to halt the progress of Great Britain's most formidable trade rival. This does not however detract from the validity of his fundamental concept of "Eurafrica," which is based on the argument that, by virtue of their respective climates, natural resources and population densities, Europe and Africa are complementary and could be so closely linked as to form a practically self-contained economic unit able to withstand all external pressure, whether from the East or the West. By a large-scale development of communications and hydro-electric schemes in Africa, enormous mineral, sylvan and agricultural resources, hitherto untapped, could be made available to all, and in their exploitation we should have the cooperation of a new generation of Africans, healthier and better equipped than their fathers for integration into the larger Eurafrican pattern of the future.

Mr. Zischka indicates how much has already been done in the way of industrial development of colonial regions, especially in the Belgian Congo and French North Africa; but he envisages much greater projects, to be undertaken by international rather than by merely national action, culminating in the creation of two inter-connected inland seas, in the Congo Basin and round Lake Chad, the second of which would have a navigable outlet to the Mediterranean and would also irrigate vast areas of the Sahara. By means of suitable barrages on the Congo and at the Straits of Gibraltar sufficient electricity could be generated to provide power not only for most of North, Equatorial and West Africa but for south-western Europe as well, conveyed by modern million-volt transmission cables over a land bridge at the Straits, where the African and European power-grids would link up. The Gibraltar barrage (for which plans already exist) would, besides this, control the flow of water from the Atlantic into the Mediterranean and enable the level of the latter to be lowered at a rate of, it is suggested, one metre a year in order to raise above its surface progressively increasing areas of cultivable land, chiefly in the Adriatic and off the present coasts of Tunisia and Tripolitania.

Although the author deals with questions of colonial administration rather in the manner of the "armchair planner" the technical fulfilment of his schemes would by no means be beyond the powers of modern science. The great question, on which everything else hinges, is whether the various sovereign states of Europe could be prevailed upon to unite on a common policy for the

development of Africa and to allocate to its realization a fraction of the money which they now spend on rearmament; but the answer to this question lies outside the scope of Mr. Zischka's book.

The bibliography provided is extensive but would have been improved by the addition of more "brass tacks" literature; as, for instance, the published reports on the working of the Gezira Scheme in the Anglo-Egyptian Sudan, which the author considers a model of what can be achieved in the coordination of European and African endeavour, as well as of State and private enterprise.

A. D.

THE MAHDYĪA: A history of the Anglo-Egyptian Sudan, 1881–1899. By A. B. THEOBALD. *London: Longmans, Green & Co*, 1951. 8½×5½ *inches;* 273 *pages; maps and illustration.* 21*s.*

The story which forms the theme of Mr. Theobald's book has been very fully told in such classics as Sir Reginald Wingate's 'Mahdiism,' Mr. Winston Churchill's 'River War,' Slatin Pasha's 'Fire and Sword,' to say nothing of many less-known works listed in the bibliography. Though Mr. Theobald has little to add in the way of facts, he brings to the narrative a fresh approach; for the Sudan which he knows and serves has changed beyond recognition in the course of fifty years, and a re-assessment of Mahdism is of particular significance at this time, when a new Sudan problem is waiting to be solved. To the contemporaries of Gordon and Kitchener the Sudan was a useless possession, a country sunk in fanatical superstition, and devastated by famine and slave-raids and war. After the reconquest it was a financial liability and, at the same time, a challenge to administrators who believed, though they would have blushed to admit it, in an imperial mission and in the White Man's burden. It is not their fault that these terms have fallen into undeserved disrepute, and that the men who created the new Sudan are decried by a generation which has forgotten its recent history. The Mahdi's Sudanese contemporaries lived in the dark ages of religion, and their Islam knew little of its medieval civilization, and less of the modernism which was beginning to stir in India and Egypt. Today, an *élite*, drawn from their sons and grandsons, speaks the language of modern democracy, and self-government and self-determination are within their grasp. The material progress of the country, as revealed in a budget which surpasses the wildest dreams of the men who laid the foundations, bears notable witness to the achievements of "imperialism." Yet Mr. Theobald's book is a timely reminder of an age from which we are separated by a span of time too brief to change the minds of a whole people. Today the Mahdi's son, Saiyid Sir Abd al-Rahman, is the head of a political party which outwardly conforms to the most modern pattern. But many of his followers see in him the heir of the man who was entrusted by Allah with a new revelation; they style him Mawlāna al-Imām, and crowds greet him with enthusiastic shouts of *Allāhu akbar*, and the world may yet learn of the re-birth of Mahdism as a politico-religious creed.

Mr. Theobald's lucid and accurate account deserves to find many readers both on account of its intrinsic interest and because of its bearing on the political problem of the day. He has not said the last word, since many Arabic documents still wait to be brought to light, and he is regrettably brief on the religious and psychological aspects of the Mahdist movement.

S. H.

THE SHOALS OF CAPRICORN. By F. D. OMMANNEY. *London: Longmans, Green and Co.*, 1952. 9×6 *inches;* viii+322 *pages; map and illustrations.* 21*s.*

This most interesting and informative book deals with those islands in the South Indian Ocean that are perhaps the sole remains of the submerged conti-

nent of Lemuria which is said to have connected India and Madagascar. In view of the strictly limited bibliography of up-to-date literature dealing with this particular area, it is a happy coincidence that two such delightful books as 'The shoals of Capricorn' and 'The island of the Swan' should have appeared almost simultaneously.

Dr. Ommanney, the talented author of 'South latitude,' was one of a Colonial Office research party which recently spent two years in a converted trawler-drifter examining the possible development of the fisheries in this area on a paying commercial basis. Fortunately for us the author was held up in Mauritius for six months, during which period he appears to have made full use of his highly developed powers of observation. The picture which he paints of life in the colony, as well as his subsequent observations on Mahé in the Séchelles, to give the Colony its correct spelling, may appear somewhat unflattering in regard to the permanently resident white populations but, by and large, his criticisms are not altogether unmerited. The ignorance at present prevailing in respect of these two not unimportant Crown Colonies is deplorable; and it must be hoped that this excellent book will do something towards dispelling this state of affairs. The description of the expedition's visit to Aldabra is most interesting and one is glad to learn that at present, at any rate, there seems little likelihood of the giant tortoises becoming extinct.

In a book of this sort it is obvious that the author must select his material most carefully if it is not to become an expanded edition of Admiralty sailing directions for the South Indian Ocean. Nevertheless, it is a matter for regret that he was unable to give us any description of the Amirante Islands lying to the westward of Mahé, or more detailed information regarding the Chagos Archipelago, or the isolated fishing community of St. Raphael in St. Brandon's Isles. The island of Rodrigues, Mauritius' largest dependency, is hardly mentioned.

The author appears to have taken special pains to verify his historical data and it is therefore somewhat surprising to learn that King Prempeh of Abyssinia was for some years an exile in the Seychelles. Presumably the late ruler of Ashanti is intended. His explanation of the derivation of the island of Mauritius' first name "Cirné" is also in the reviewer's opinion, somewhat far-fetched. Cirné is said to be derived from Cernas, the name given by the Portuguese, who discovered the island about 1507, to the indigenous fruit bats which they found there. The more generally accepted explanation is that it was the name of Fernandez Pereira's ship, the *Cirné*, or to be more exact, the *Cisné* or *Swan*.

H. A. J. de L.

TABVLAE GEOGRAPHICAE QVIBVS COLONIA BONAE SPEI ANTIQVA DEPINGITVR. Eighteenth century cartography of Cape Colony. *Amsterdam and Cape Town: N.V Hollandsch-Afrikaansche Uitgevers Maatschappij*, 1952. 12×16 *inches; 64 pages; 11 folding map facsimiles (9 in colour); diagrams.* (Text in English, Dutch and Afrikaans.) *Twelve Guineas*

In 1950, Mr. C. Koeman found a number of manuscript maps in the archives of the Topographical Service at Delft, which on examination proved to be of great significance for the cartographical history of Cape Colony. The more important of these, with other maps for comparison, have now been reproduced in colour in this volume, published by the Royal Netherlands Geographical Society and other bodies as a contribution to the Van Riebeeck celebrations.

These maps were originally assembled by C. J. van de Graaf, who was Governor at the Cape from 1785 to 1791. In initiating a defence scheme he

felt the need of a good topographical map; little of the work of earlier inland expeditions had found its way on to published maps, which were based largely on outlines from marine charts. Van de Graaf proceeded therefore to assemble these surveys and to compile a general map. This was drawn on the scale of approximately 1 : 500,000 and covers the country south of the parallel 32° S. and south-west of the Great Fish river. The map is carefully drawn with water-courses, routes, settlements and natural vegetation indicated. Relief is shown mostly by a style of hachuring and hill-shading, which being done with a wash is more pleasing than the rather crude efforts of contemporary engraved maps.

In the introduction, Mr. Koeman examines the scientific basis of the surveys on which this map was built up. In general, methods employed at sea were applied as far as possible to land survey. The Dutch surveyors do not seem to have been abreast of the most recent developments; it is uncertain whether they used the octant and they calculated longitudes from Cape Town from the distances traversed, since they did not use chronometers. Similarly distances by sea were determined from estimated speeds. In earlier years at least, latitudes were sometimes calculated in the same way, in preference to observed figures. The editor concludes that errors in latitude might amount to 5′ or 10′ by the older methods, and that the longitudes might be out by 1 degree.

In 1804, John Barrow published a map of the Colony, based on his own surveys, with his 'Travels into the interior of South Africa,' and this has generally been considered the first general map. In his text he observes that the Dutch had not produced anything comparable to it, being unaware that van de Graaf had very rightly carried off his map collection to prevent its falling into English hands. Mr. Koeman is justified in asserting that Barrow had been forestalled, but as Barrow's map was published, it exercised considerable influence on the cartography of the Colony. Though it is said that "Barrow's work was not superior to the older general maps," in some details it is an improvement on the Van de Graaf map. The latter, for instance, appears to confuse the upper course of the Grote river with that of the Olifants, and omits its lower course, while Barrow gives a fair representation of the whole of the Grote river. However, this finely produced publication makes it clear that the Dutch had not neglected the mapping of their settlement, and explains how this fact has only recently been recognized. As a monument to Dutch eighteenth-century survey in South Africa, which was the equal at least of that in any extra-European country, its appearance is timely. G. R. C.

AMERICA

THE TECTONICS OF MIDDLE NORTH AMERICA: Middle North America east of the Cordilleran System. By PHILIP B. KING. *Princeton: University Press* (*London: Geoffrey Cumberledge*), 1951. 10¼×7 *inches;* xx+203 *pages; maps and diagrams.* 24*s.*

In almost every field of modern study the accumulation of detailed facts and specialized information is accelerating at such a pace that it is becoming increasingly difficult to obtain a broad picture that incorporates the results of recent work without being obscured by technicalities. In geology the mere bulk of published information is becoming so unwieldy that non-specialists and workers in allied subjects, including most geographers, are tempted to ignore modern advances and depend for their information on the old "reliable" texts that were written before the forest was obscured by so many trees. This book, although written primarily for geologists, is such a concise summary and synthesis of an immense amount of detailed, up-to-date information that it will be

welcomed by all geographers who have occasion to deal with the crustal development and present constitution of the North American continent.

A member of the United States Geological Survey, Dr. King is one of the foremost structural geologists of the day, well-known as the author of the heretofore standard descriptive work in the field of American tectonics, 'An outline of the structural geology of the United States' (the Guidebook of the XVI International Geological Congress), and as editor of the 'Tectonic Map of the United States.' His present book is part of an ambitious undertaking to compile a modern description and interpretation of the regional geology of the United States, southern Canada, and northern Mexico. This first volume deals with that part of the continent east of the North American Cordillera. It includes the "Central stable region," consisting of the Laurentian Shield and the Interior Lowlands, and the "Structures south-east and south of the Central stable region," which comprise Newfoundland, the northern Appalachians, the central and southern Appalachians, the structures west of the Mississippi river (Wichita-Ouachita systems), and the coastal plains. Within this classification, the various geographical areas are discussed independently and systematically in separate essays. The form of treatment (general character—stratigraphy—structure—external relations) is similar to that of many Geological Survey publications. Each essay concludes with a well-chosen and briefly annotated bibliography. A single index, complete as to place-names, but less so as to subject matter, serves the whole book. A useful feature is the reference to text-figures in the index.

Most of the text is descriptive, but the constantly changing perspective as local phenomena are fitted into a regional picture necessitates frequent reference to theoretical considerations such as the development of geosynclines, the role of foreland areas, etc. In most places fact and inference are kept admirably distinct. An excellent short chapter on the "general and theoretical considerations" of mountain systems of deformed rocks should help geographers to a better understanding not only of the remainder of this book, but also of many other useful geological papers whose significance might otherwise be missed by the non-specialist. In general, the author has avoided being dogmatic in condensing much information and many opinions into a few lines. Most controversial questions are neither by-passed nor pronounced upon, but presented as arguments left open. Only in a few places does Dr. King commit himself, as for example in his rejection of the supposed borderland "Appalachia" as a source of Palaeozoic sediments to the east of the present Appalachian chain. Protagonists of the "Sudbury controversy" may wince at his abrupt dismissal of the question as to origin of the nickel eruptive, but none can object to his statement.

One of the most valuable contributions made by the book is the bringing together and equating of information from scattered sources. Readers from outside North America will welcome the lucid treatment of the Laurentian Shield as a unit, and the explanation of the relation between the different terms in use in the United States and Canada. The summary of the geology of Newfoundland and its relation to the Appalachian System partly fills a peculiar gap in geological literature; for there has until now been no satisfactory general synopsis of the large number of scattered investigations carried out on the island, many of which have shown earlier conclusions to be in error. Much of the recent information on structures in the United States has resulted from deep drilling and geophysical exploration, and has previously been available only in specialized technical publications.

The care with which the whole book is constructed is shown in the numerous structure-sections, which are essential to the argument. Although gathered

from many different sources, all the long regional sections have been redrawn to the same scale and vertical exaggeration so that the degree of deformation, stratigraphic thinning, etc. can be compared throughout the book. Local maps, in the form of text-figures, are plentiful but the author has wisely refrained from attempting to include an overall map of the entire area covered. The book is intended to be studied in conjunction with the standard United States, Canada, and Mexico geological maps, and especially the 'Tectonic map of the United States' [1] and the 'Tectonic map of Canada.' [2] In many respects it could be considered an elaborate handbook to these two maps.

There are very few annoying inconsistences. In several places names of structural features are casually introduced a page or two before they are properly described. There are few references to text-figures in the body of the text, and the author's style is so fluent that the concentrating reader is likely to go right through a text description without noting the diagram that would make its understanding easier. The text is planographed, but the typing is clear and, although light in face, easily readable.

Any book of this nature runs a risk of being either too involved for its theme to be grasped all at once, or too condensed to be a useful reference on any particular problem. Dr. King's mastery of his subject is such that he strikes a balance which largely avoids these pitfalls. Although its subject is but a single continent, this work, in its scope, accuracy of detailed information and synthesis invites comparison with Suess' monumental 'Das Antlitz der Erde.' The task of compiling such a work at the present time is immeasurable greater than it was three generations ago, and it has been said with justification that no one man could now do it for the whole earth. If however the parts of his treatise still to come are of the same standard as this first volume, Dr. King will have presented a description and interpretation of North America that may become as useful to modern geologists, geographers and all students of earth science as was Suess' classic work to their predecessors. E. F. R

PHYSICAL

PHYSICAL GEOGRAPHY. By R. F. Peel. *London: English Universities Press*, 1952. 7½×5 *inches;* xiii+290 *pages; diagrams.* 10*s* 6*d*

It is not an easy task to cover the well-known and yet rapidly developing field of physical geography in a readable manner in a book of less than 300 pages. But this is what Professor Peel has achieved in this the fourth volume appearing in the series *Teach Yourself Geography* edited by Professor Debenham. Written with enthusiasm and conviction this little book should introduce many people to the study of the problems of the land, air and water which form our physical environment.

Since this book is intended primarily for the layman, Professor Peel rightly sets out to "convey broad ideas rather than detailed facts." He takes as his theme that the value of physical geography lies in the fact that it pays particular attention to the delicate balance of the physical forces at work on the surface of the earth, and throughout the book the various aspects of their ceaseless interchange and inter-relations are kept well before the reader. With this end in view the volume follows a well-considered plan. The author begins by examining the main characteristics of the earth and the possible origin of the continents and mountains and then goes on to describe the agencies which have carved

[1] American Association of Petroleum Geologists, 1944.
[2] Geological Society of America, 1950.

out the present landscapes. Next, he considers the influence of climate upon the production of landforms and this leads to a discussion of the main climatic factors and their variations. The final chapters are concerned with the circulation of water on land and in the ocean, and conclude with the physiography of coasts.

In covering so vast a subject it is impossible to give a completely even treatment of all topics and it is not surprising that some of the problems appear over-simplified, as for instance in the chapters on mountain building and vulcanicity. The book also suffers from occasional over-emphasis of certain topics, as is noticeable in the part dealing with the influence of rock types on landscape development. Further, while new lines of work are indicated in some chapters they are omitted from others. It might have been better also to expand the final chapter on the problems of soil erosion and water supply, or incorporate the material into the earlier part of the book. Despite these comments however, the author has succeeded in arousing the reader's curiosity and in encouraging him to think for himself. The parts of the book concerned with the complexities of climate are particularly successful.

A feature of the book is the large number of clear illustrations, both diagrams and sketches, drawn by the author. These have been well reproduced, but the lack of an adequate scale detracts from the value of some of the sketches; this is especially noticeable in Figure 18. The style and general set-up of the book are good and the price is reasonable. M. M. S.

GENERAL

MODERN GEOGRAPHERS: an outline of progress in geography since A.D. 1800. By G. R. CRONE. *London: The Royal Geographical Society* and *John Murray*, 1951. $8\frac{1}{4} \times 5\frac{1}{4}$ *inches;* 56 *pages; maps and illustrations.* 3*s* 6*d*

The frontispiece of this brochure is an enchanting portrait of the young Alexander von Humboldt seated under a tree, and glancing up for a moment from the botanical specimen that he is examining. The artist has set Karl Ritter, too, out of doors, pencil and notebook in hand yet pausing good-humouredly and prepared for interrogation. But the drab century was at hand. Important men demanded to look important, and all the rest are shown indoors and with a book save only Halford Mackinder, who in old age and retirement rests on a stone bench. Mr. Crone does not however introduce us immediately to the Founder of Modern Geography, the chapter devoted to von Humboldt being preceded by one on Sir Joseph Banks. Here was the typical man of science of those days, the man wealthy enough to move about the world at will, gathering material at first hand. Baulked of his intended second voyage with Captain Cook, he could charter his own vessel, take his scientific party to Iceland and climb Mount Hecla. Later in life he could rule over the Royal Society for more than forty years, ample time to establish among the Fellows an attitude towards Geography which would have greatly surprised Robert Hooke and Edmund Halley. The long-lived Banks was outmatched by von Humboldt, whose life-span was ninety years, and who was linked with Cook through Johan Georg Forster, the young naturalist of the *Resolution*. Even given his long life the volume of his work was prodigious, and the influence of his ideas hardly less great. Karl Ritter was but ten years his junior, and can claim to have laid the foundations of that minute attention to the terrain which later characterized the Prussian officer. Among his pupils was Von Moltke. The foundation of the Berlin Geographical Society preceded by nearly ten years that of its London counterpart which fell successively under the magisterial sway of Sir Roderick Murchison and Sir Clements Markham and owed much of its *réclame*

to its intimate association with the great explorers of Africa and the Arctic. As might be expected, the Officers and Fellows as a body showed little interest in the philosophy and methodology of Geography, and the solitary Chair founded at University College, London, in 1833 nearly died of inanition. The Society was in fact very largely a Travellers' Club, and its membership, of service personnel, diplomats and gentlemen of leisure, reflected the classes to whom opportunities for extended travel were open. In France the combined influence of Humbolt and Ritter may be traced in the monumental 'Géographie universelle' of Elisée Reclus with its significant sub-title 'La terre et les hommes,' while a not very much younger man, Paul Vidal de la Blache, by his brilliant analysis of the *pays* of rural France introduced the regional concept much as we understand it today. The striking work of his maturity, 'Tableau de la géographie de la France,' appeared in 1902, just in time to provide a formative text-book for students at the fledgling Oxford School of Geography founded in 1899. It was matched by Mackinder's equally brilliant and stimulating 'Britain and the British seas' which also came out in 1902. Meanwhile in Germany Friedrich Ratzel, starting from the concept of the State as an organism, had already written his great 'Anthropogeographie,' and followed it by his 'Politische Geographie,' twin roots from which geographical determinism, the cry for *Lebensraum* and *Geopolitik* were all alike to spring. During the same period the Baron von Richthofen was making those great journeys through China as a result of which he laid the foundations of geomorphology, a study to which many English Professors of Geography are now largely addicted. The story of Sir Halford Mackinder and of the strange fortunes of his prophetic vision of the globe in terms of 'heartland' folk arrayed against peoples of the 'periphery' is told afresh by Mr. Crone with great skill and judgment. Yet despite his carefully reached conclusion, that true though it might be of its own day the dichotomy hardly holds good in this era of freedom of the skies, do not the facts belie him? For who are the protagonists of the Cold War if not the peoples of the unbroken land-mass, the fenced-in peoples, on the one hand and the peoples of peninsulas and islands, the free ranging seaboard peoples, on the other? Enough has been said perhaps to indicate that within the compass of its fifty odd pages this pamphlet contrives to be richly informative and yet provocative, and since the author provides us in addition with a carefully thought-out bibliography of source material 'Modern geographers' deserves a place on the bookshelves of every serious student of the subject whether young or old. E. G. R. T.

CARL LINNAEUS. By KNUT HAGBERG. Translated from the Swedish by ALAN BLAIR. *London: Jonathan Cape*, 1952. $8\frac{1}{4} \times 5\frac{1}{4}$ *inches;* 264 *pages; maps and illustrations.* 18*s.*

Carl Linnaeus, or Carl von Linné as he preferred to be called after his ennoblement, will be remembered mainly for the system of classification bearing his name, which brought order out of chaos in the nomenclature of animals and plants. It is often forgotten that in his early days he was an extensive traveller, not only in his native Sweden but also in other parts of Europe, and wrote interesting accounts of his journeys. Like many students of his time he went to Holland for his medical education, graduating at Hardewijk, and from there went to Leiden. Here was published the first edition of his famous *Systema Naturae* in 1735, which at once established his name in the world of learning. The following year he came to England and visited the botanical gardens at Chelsea and Oxford, returning to Sweden via France in 1738, already a famous man at the age of thirty-one.

THE GEOGRAPHICAL MAGAZINE

needs no introduction to Fellows of the *Royal Geographical Society*. Successive Presidents have drawn attention to its importance as a means of making the geographical point of view known among a wide public; and, especially, to the value of the Trust Fund for the advancement of exploration and research and the promotion of geographical knowledge, which receives half the magazine's profits under the terms of a Trust Deed. The Trustees, of whom the President of the Society is *ex officio* Chairman, have thus had some £6580 placed at their disposal since 1945.

Profits are ultimately dependent on circulation; and not only the increase, but also the maintenance of the Magazine's circulation depend, in turn, on securing new readers. The economic difficulties of the present time are causing a loss of subscriptions which needs to be made up; and Fellows of the Society are cordially invited to help in this task. If they or any members of their families wish to show their interest in the Magazine by doing so, full details will be sent of an advantageous arrangement whereby they may benefit from each new subscription obtained.

Enquiries should be addressed to

THE CIRCULATION MANAGER

THE GEOGRAPHICAL MAGAZINE

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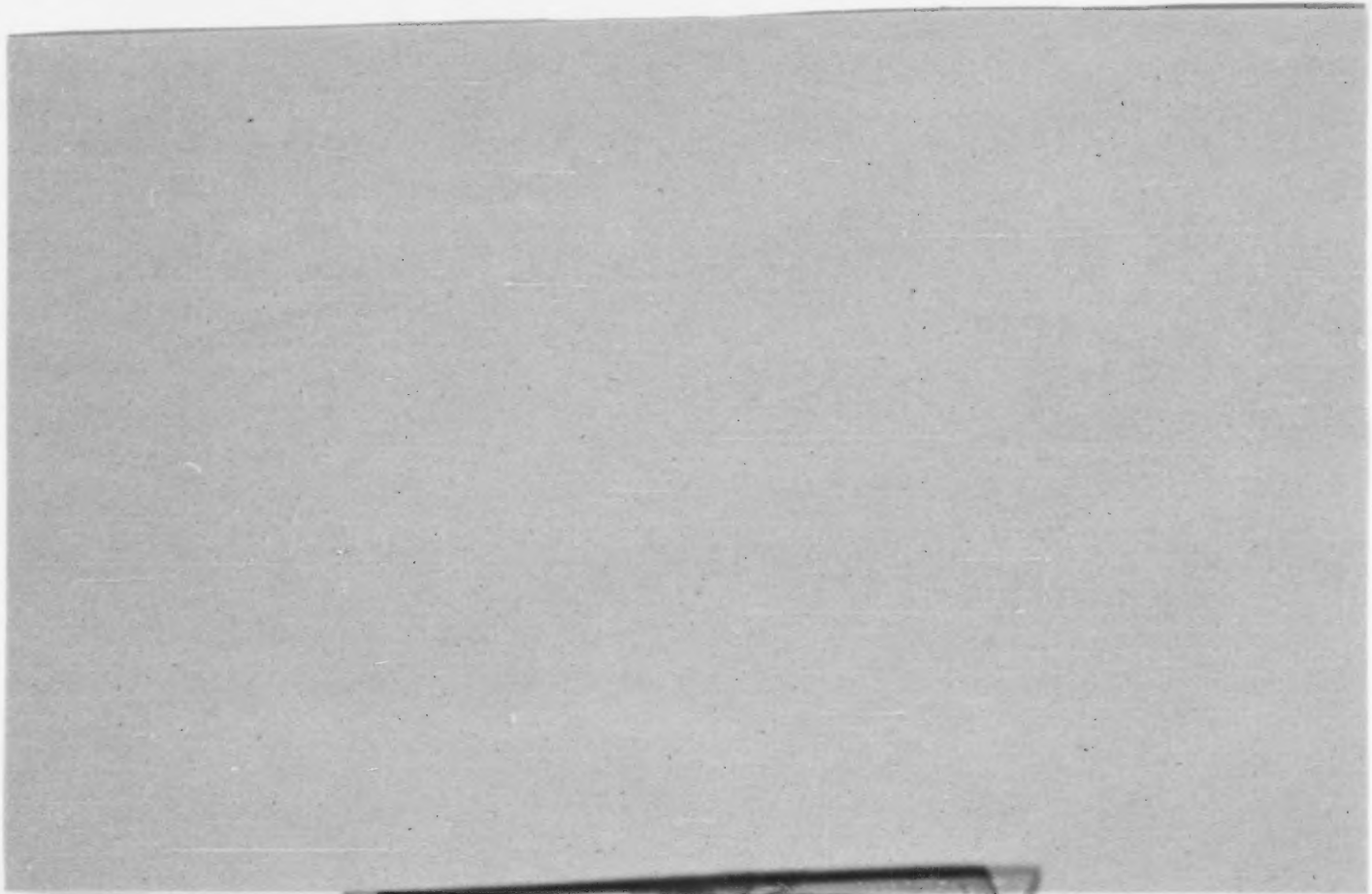

Previously, in 1732, he had made his most important expedition, undertaken mainly with the object of studying the botany, geology and zoology of Lapland. His remarkable discoveries and observations are described in *Flora Lapponica*, written in Latin, and published in Amsterdam in 1737. The Swedish diary of this journey was not published until 1811, and soon after its appearance was translated into English by J. E. Smith, president of the Linnean Society of London, under the title of '*A tour in Lapland.*'

After practising medicine in Stockholm for a few years Linnaeus was appointed to a chair at the University of Uppsala, where he worked for the remainder of his life, though he made further journeys in some of the Swedish provinces. The descriptions of his journeys to Öland and Götland in 1741, Västergötland in 1746 and Skåne in 1749, are among the finest writings in Swedish literature and fully justify Linnaeus' claim to consideration as a geographer. There is little doubt that he laid the foundations of Swedish geographical research by the interest he aroused in the study of his native country and Lapland. Moreover his students, inspired by his lectures, travelled to many parts of the world, and one of them, D. C. Solander, settled in England and later accompanied Cook on his voyage round the world in 1768–71.

The author throws new light on certain aspects of Linnaeus' very complex character. He never doubted that it was through the especial dispensation of Providence that he had been chosen to discover the coherence of existence, the affinity of the species, and that his *Systema Naturae* was a world doctrine: "there is no God other than nature and Linnaeus is his prophet." *Philosophia humana*, the subtitle of his original manuscript, *Lachesis Naturalis*, gives a good idea of what Linnaeus taught in his lectures on dietetics, and apart from food and drink, apparel and bodily movement, it touches upon the ultimate objects of life, on questions of happiness, death, and of God. He took a dark view of human life, and never tried to gild reality. He anticipates Darwin in his idea that existence is a struggle of all against all, as shown in one of his poetic fancies:—

"I saw mankind consume all animals, all plants and all earth.
The beasts of prey lived on herbivora.
The birds of prey lived on small birds, which ate seeds and worms,
The plants lived on the soil.
Hence I went first to the soil, where it all began.
The humus under a microscope was only *desumta animalia et plantae.*"

There are many links between Linnaeus and this country and in the words of the author "after his death Linnaeus became an English citizen." His collections and manuscripts were removed to London and remain in the care of the society which has done most to preserve his memory—the Linnean Society of London.

This work is a brilliant study of Sweden's greatest son, and brings out to the full Linnaeus' extraordinary originality and industry; also his influence in Britain and the Linnean tradition in this country. It is issued under the auspices of the Anglo-Swedish Literary Foundation. E. H.

THE SOCIETY'S NEWS

THE NEW COUNCIL AND OFFICERS OF THE SOCIETY

Among the elections made at the Annual General Meeting on June 23 are the following new appointments. Mr. Louis C. G. Clarke, a member of Council and formerly Director of the Fitzwilliam Museum at Cambridge, becomes a Vice-President of the Society. Lord Rennell of Rodd, a former President of the Society, becomes one of the Trustees. Dr. Edward Hindle, F.R.S., a member of Council and formerly Scientific Director of the Zoological Society, becomes one of the Honorary Secretaries.

Members of Council who have not previously served are Mr. J. O. M. Clark, formerly a member of the Finance Committee; Dr. Alice Garnett, Lecturer in Geography at Sheffield and Honorary Secretary of the Geographical Association; Mr. W. E. Hampton who was a member of the Greenland expedition of 1930–31 and the British Graham Land Expedition of 1934–37; Professor Gordon Manley, Professor of Geography at Bedford College, London, and a former President of the Royal Meteorological Society; Captain R. E. D. Ryder, R.N., V.C., M.P., who was also a member of the British Graham Land Expedition; Mr. R. A. Skelton, Superintendent of the Map Room, British Museum; and Brigadier J. C. T. Willis, O.B.E., Director of Military Survey.

HONOURS TO FELLOWS OF THE SOCIETY

Among the Honours recorded in the Birthday Honours List for June 1952 are the following, bestowed upon Fellows of the Society. Sir Peter Alexander Clutterbuck, Knight Grand Cross of the Order of St. Michael and St. George; Sir Ambrose Keevil, Knight; and Mr. F. Kingdon-Ward, Officer of the Order of the British Empire.

THE GEOGRAPHICAL ESSAY PRIZE, 1952

On the recommendation of the examiners, the Council has awarded the Geographical Essay prize of £10 to Mr. Martin Brunt of Fitzwilliam House, Cambridge, for an essay on "A consideration of some of the East Anglian eskers." Two other essays were highly commended: an essay by Mr. F. V. Emery of Jesus College, Oxford, on "The English settlement in peninsular Gower, South Wales," and an essay by Mr. Brian Wills of St. John's College, Cambridge, on "An investigation of the relationship between surface and subsurface erosion in the limestone area of western Mendip."

The prize is offered each year for either a critical survey of recent additions to knowledge in a limited geographical field or a discussion of some current problem in its geographical aspect. Candidates must be undergraduate students reading geography at a university of Great Britain or Northern Ireland during the academic year in which they submit the essay. Essays submitted for the next award must reach the Director and Secretary by 15 January 1953. The Council reserves the right to publish or to retain for the Library any of the essays submitted for this prize.

APPLICATIONS FOR GRANTS FOR EXPLORATION AND RESEARCH, 1953

Applications for grants must reach the Director and Secretary not later than 1 March 1953; it is only in very exceptional circumstances that late applications can be considered. Applicants should state (*a*) their scheme of research or

scientific programme; (*b*) the names, number and qualifications of members of the party; (*c*) length of time to be spent in the field; (*d*) total estimated cost; (*e*) names of other institutions to which they have applied for help; (*f*) the amount of the grant, and any other assistance, that they request. Applications should be accompanied by two letters from qualified institutions or individuals supporting the proposed expedition of research. ***All applications must be typed.*** Leaders of expeditions and applicants for grants will be expected to attend an interviewing board.

THE RECORD

CONTRIBUTORS TO THIS ISSUE OF THE *JOURNAL*

The Right Hon. The Earl of Verulam is Chairman of Enfield Cables Ltd. He is President of the Institute of Industrial Administration and the author of many articles on industrial and planning subjects. *J. Houston Angus*, now Chairman of the Nigerian Electricity Board, was lately Director of the Power Division, United Nations Economic Commission for Europe. *S. Chaplin*, a colleague of Lord Verulam, is a Member of the Institution of Electrical Engineers. Lieutenant-Colonel *P. D. Baird* is Director of the Arctic Institute of North America at Montreal. Brigadier *G. F. Heaney*, C.B.E., was, until his retirement this year, Surveyor General of India. Professor *S. W. Wooldridge*, D.SC., is Professor of Geography at King's College, London, and a frequent contributor to the *Journal*; he has published many papers on the physical geography of south-eastern England. *Dr. W. B. Harland* is a Fellow of Gonville and Caius College and a University Lecturer in Geology at Cambridge; he has made a number of expeditions to Spitsbergen and was awarded the Society's Cuthbert Peek grant in 1951. Professor *A. Davies* is Professor of Geography at the University College of the South West, Exeter, and has published several papers on the early voyages of discovery. *Dr. H. C. K. Henderson* is a lecturer in geography at Birkbeck College, London, who has made a special study of the agricultural geography of England during the past two hundred years. Professor *E. G. R. Taylor*, D.SC., LL.D., Emeritus Professor of Geography in the University of London, is one of the Society's Victoria Medalists and a frequent contributor to the *Journal*.

THE MANCHESTER CONURBATION

In his article on "English conurbations in the 1951 Census" (*Geogr. J.* 118 (1952) 64–8), E. W. Gilbert shows that in South-east Lancashire (and Cheshire) seven county boroughs, fifteen municipal boroughs, twenty-nine urban districts and two rural districts covering 379 square miles have in all a population of 2,421,011, of whom two million live in Lancashire. In the Preliminary Report of the 1951 Census, this conurbation (perhaps better named after Manchester) is divided into two sections, Lancashire and Cheshire; a division that is a further tribute to our impregnable county boundaries. But it may be questioned whether this division by county boundaries is really of much significance now. As Professor C. B. Fawcett showed (*Geogr. J.* 79 (1932) 100–13), the conurbation has an inner core and a number of major satellite towns, Bolton, Bury, Rochdale, Oldham, Stockport and Altrincham; all of these are manufacturing and shopping centres having various other towns in close association with

them. Altrincham, for example, is part of a suburban and industrial area which extends from the Mersey at Sale to the open Cheshire countryside south of Bowdon and Hale; in these four places, Sale, Altrincham, Bowdon and Hale, there are approximately 100,000 people. Immediately to the east of this built-up area the Wythenshawe estate is spreading week by week, so that within a few years houses will extend continuously to Wilmslow and Alderley Edge, more than ten miles from the centre of Manchester. Elsewhere within the conurbation, houses are added so quickly that every published map is out of date before it comes off the press so that eventually there will be no such thing as an inner core and a circumference of towns, but only one built-up area in two counties with fifty-three governments—probably more.

At the same time, one must recognize that Stockport, Oldham, Rochdale, Bury, Bolton and even Altrincham all have a sturdy individuality. Some of their inhabitants work in Manchester but others come in to work in their factories offices and shops; their retail markets, shops and services compete with those of Manchester. It may still be reasonable to divide the conurbation into two—an inner core having a continuously built-up character and an outer area composed chiefly of manufacturing towns—but within twenty years, even ten years, the position will have materially changed as it has done between 1931 and 1951.

In 1931, all the towns of Professor Fawcett's inner conurbation were in Lancashire; they included the cities of Manchester and Salford, the borough of Eccles and the urban districts of Droylesden, Prestwich, Stretford, Swinton and Pendlebury, and Worsley; of these all except Droylesden and Worsley have since become boroughs. Building between the wars has now so united independent towns that it would seem reasonable to add to the inner conurbation the urban districts of Audenshaw, Denton, Failsworth, Middleton and Urmston, all in Lancashire; and in Cheshire the county borough of Stockport, the municipal boroughs of Altrincham and Sale, and the urban districts of Alderley Edge, Bowdon, Bredbury and Romiley, Cheadle and Gatley, Hale, Hazel Grove and Bramhall, and Wilmslow. This change is due almost entirely to residential development and therefore shows the extension of settlement on the more favoured south side of the conurbation, away from the smokier and wetter north side and close to the open Cheshire countryside or to the breezy slopes of the Pennines.

The definition of the Merseyside conurbation in the Census seems cautious on the Lancashire side; for there is now virtual continuity of housing to Prescot, which in turn is practically joined to St. Helens.[1] Sir Patrick Geddes in 'Cities in evolution' suggested that there was in Lancashire only one conurbation, which he called "Lancaston";[2] the observation was apparently based on a generalized population map reproduced in the book. The suggestion was perhaps premature, but yet prophetic for year by year housing estates are added on the periphery of each town between Liverpool and Manchester. The Lancashire coalfield towns and villages to the west of Eccles, including Tyldesley, Atherton, Leigh, Westhoughton and Hindley, are almost joined to Wigan, which is joined by a further series of mining centres to St. Helens, Prescot and Liverpool. True, there are agricultural enclaves—but the original definition by Professor Fawcett allows for this: to quote, "a conurbation is an area occupied by a continuous series of dwellings, factories, and other buildings, harbour and docks, urban parks and playing fields etc., which are not separated from each

[1] Bradbury, R., "The Technique of municipal housing in England with particular reference to Liverpool," *Town Planning Review*, **22**, 42–71, esp. p. 45.

[2] Geddes, P., 'Cities in Evolution,' London 1915, p. 35 and map p. 31.

other by rural land; though in many cases such an area includes enclaves of rural land which is still in agricultural occupation." (*Geogr. J.* 79 (1932) p. 100).

Expansion of settlement does not necessarily mean an increase of population; the Manchester conurbation, as defined in 1951, had decreased by 0·3 per cent. This is a significant figure because the definition of the conurbation is sufficiently wide to include the residential areas as well as the towns having decreases due to the outward movement of workers and, in the case of towns whose main industry is cotton spinning, the decline of employment in textile industries. These two causes of declining population may account for the loss of population between 1931 and 1951 in, for example, Bolton (−6 per cent.), Ashton-under-Lyne (−11 per cent.) and Stalybridge (−10 per cent.): conversely many towns of a more residential character show large increases, such as Prestwich (+44 per cent.), Altrincham (+36 per cent.), Sale (+54 per cent.), Wilmslow (+63 per cent.). Further, the Lancashire section of the conurbation showed in 1931–1951 a decline of 4 per cent. but the Cheshire section an increase of 21 per cent.; meanwhile, Manchester itself has declined by 8 per cent. and Salford by 20 per cent. But where is the outward movement to stop? Those able to afford the train fares may travel daily from Southport (35 miles) in 48 minutes, from Chinley (20 miles) in 30 minutes, from Buxton (31 miles) in 60 minutes, from Knutsford (15 miles) in 40 minutes and even from Colwyn Bay (80 miles) in 120 minutes. And they do. T. W. F.

THE CENSUS OF 'IRAQ, 1947

Attempts to enumerate the population in the area now known as 'Iraq were made by the Ottoman Turkish regime, during the period of the British mandate (1919–1932) and after the country had gained its independence.

The enumeration from these precursors to the first full census were inaccurate, owing to the prejudices of the population and the imperfections of administration in remoter districts. For the 1947 Census a new Department was established in Baghdad, and methods of organization were applied which have proved effective in western countries. Even so it is believed that the recorded totals fall short of the real population by perhaps as much as 20 per cent. Provisional totals for each *liwā* (province) of the country have been available for some time, and have been published in the *Statistical Abstract for Iraq*. The tabulation of the revised results has been delayed by the time required to obtain computing machinery and to train a staff; but the detailed tables are now complete in MSS. (in Arabic) for ten out of the fourteen *alwiya* (sing. *liwā*) and it is expected that the full results for the Baghdad *liwa* (in Arabic, with English headings to the columns in the tables) will be published later this year. The summary of the census given in this note has been based upon the MSS. and proofs.

The 1947 Census was confined to the liwas of 'Iraq, and excluded the two territories—the Northern and Southern Deserts—west of the Euphrates and inhabited mainly by nomads. The total population recorded in the fourteen liwas was 4,749,788; but in three of these—Karbalā, Dulaim and Mōsul—the totals included nomads estimated to number 170,000. The settled or sedentary population of 'Iraq thus numbered 4,579,788. Of this total, 29 per cent. lived in towns having 3000 or more inhabitants. Of these, 11 per cent. lived in the urban area of Baghdad, which just exceeded the half-million (502,068). Eight per cent. lived in the next four largest towns, inhabited by 50,000–150,000 persons (Mōsul, 133,625; Basra, 101,530; Kirkūk, 68,308; Al Najaf, 57,949). A further 6 per cent. inhabited the eight towns having populations between 20,000 and 50,000: (Kādhimain, 48,678; Karbalā, 44,150; 'Amāra, 36,907; Hilla,

36,577; Sulaimānīya, 33,510; Erbil, 27,036; Dīwānīya, 20,015; Al Nāsirīya, 20,713). Another 3 per cent. lived in eight towns in which the total of inhabitants fell between 10,000 and 20,000; and 3 per cent. lived in twenty-two towns containing from 3000 to 10,000 persons.

The liwas may be divided, for the purposes of broad comparison, into two groups. Into the first may be assigned those in which the basic element of the economy, agriculture, is dependent upon irrigation. These include Basra, Muntefiq (Al Nāsirīya), 'Amara, Hilla, Dīwānīya, Karbalā, Kut, Dulaim, Baghdad and Diyālā—except for the *qadha* (district) of Khāniqīn. The total population of these liwas was 3,245,623, or 70 per cent. of the sedentary population of the country. These liwas of course contain the capital and the only port, Basra, which are cities functionally related to the whole country; but making allowance for this fact it seems evident that about two-thirds, or rather less, of the population is supported, directly or indirectly, from irrigated agriculture. About one-third is supported by pastoralism and unirrigated agriculture in the four remaining liwas of Sulaimānīya, Kirkuk, Erbil and Mōsul.

J. H. G. L.

UNIVERSITY NEWS

UNIVERSITY OF CAMBRIDGE

There have been several changes of staff since the last reference to geography at Cambridge appeared in the *Journal* (115 (1950) 261–2). Mr. Caesar has been appointed to the University Lectureship vacated by Mr. Peel on his appointment to a second Chair of Geography at the University of Leeds; Mr. J. H. Paterson has returned to Cambridge as University Demonstrator after two years spent in the U.S.A. as a Commonwealth Fund Fellow, and Mr. C. T. Smith has been appointed a University Assistant Lecturer having been on the Geography Staff of University College, Leicester, since graduating at Cambridge. Mr. Paterson's interests lie mainly in political and regional geography, and those of Mr. Smith in historical geography. Mr. Stanners retires in September and his University Lectureship will be filled by Mr. Farmer.

Several members of the staff have written books recently:—Mrs. Steers' 'Czechoslovakia' and Miss Mitchell's 'Historical geography,' in the *Teach Yourself Geography* series, will soon be ready. The latter will complete the five volumes: 'The use of geography' by Professor Debenham—editor of the series—'Economic geography' by Mr. Thatcher; 'The geography of living things' by Mrs. Anderson; and 'Physical geography' by Professor Peel. Mr. Grove's two reports on his research on soil erosion in Nigeria have also appeared, and his field work is being continued this summer during a four month visit. Mr. Farmer spent the Long Vacation and Michaelmas term of 1951 in Ceylon, extending the work he began there during the war; he is now engaged in writing a book on Ceylon for the Royal Institute of International Affairs which, in addition to the Leverhulme Trust, gave him considerable financial support. A number of research students and undergraduates have made repeated visits to the Jotunheim to help with the programme of glaciological research planned by Mr. Lewis. Physiographical research in East Anglia by Professor Steers and Mr. Williams, on Chesil Beach by Mr. Lewis, and in the Cambridge area by Mr. Sparks, has also made use of undergraduates' help. Work on stream flow and wave action in the Advanced Physiographical Laboratory has continued at a standard intermediate between that of teaching and research. A particular feature of the latter has been the making of two films, one on wave action and the second on stream profiles and the recession of knick points. Films were also made of the work in Norway and at Chesil.

The new syllabus for the Tripos has now been approved by the University and will come into force for the students starting their University course in the Michaelmas term, 1953. The Qualifying Examination at the end of the first year will be replaced by a Preliminary Examination designed so as not to interrupt the essential unity of the two year' course leading to Part I of the Tripos. It will no longer act, like the Qualifying, as a compulsory hurdle for those proceeding to Part I. The most substantial change in the Preliminary as compared with the Qualifying Examination will be the introduction of a part paper on translation from either French or German. Cartography and Survey will form one paper in Part I of the Tripos, and there will be three papers entitled 'Human Geography' to avoid the somewhat meaningless subdivision of the subject into Economic, Historical, Political and Regional Geography which is a weakness of the present Tripos. The major alteration in Part II of the Tripos is that the present specialization in two sides of Geography will be replaced by specialization in one of the following: (*a*) Geography of the modern world—advanced study of Economic, Political and Regional Geography included in Part I under the title of Human Geography; (*b*) Historical Geography; (*c*) Advanced Physiography; (*d*) Geodetic and topographical surveying. In addition, all candidates will have to take two papers on a common geographical theme under the general title 'The evolution and significance of geographical thought.' This will include the growth and development of geographical ideas, the character of the various national schools of geography, the relation of geography to cognate subjects, and biogeography.

The geographical essay now submitted for Part I of the Tripos will, in future, be written in the third year for Part II. The extra maturity of the students and their fuller geographical knowledge should lead them to derive more benefit from the independent and sometimes original work involved in writing these essays.

It is hoped that this revision, together with considerable changes in the courses on human geography, will lead to greater unification within the subject than results from the present syllabus. W. V. L.

GEOGRAPHY IN CANADA

The Presidential Address to the Association of Pacific Coast Geographers, delivered by J. Lewis Robinson of the University of British Columbia in June 1951,[1] summarizes the development of geography as a university subject in the Dominion and the increasing employment of geographers in the public service.

Although geography has been taught to a varying extent in Canadian schools, it was in the province of Quebec that it first attained a university status, the Chair at the School of Higher Commercial Studies (University of Montreal) having been founded in 1910, and in Quebec there has been a continuing association with French geographers. Jean Bruhnes taught at Montreal as a visiting professor from 1925 to 1927, Raoul Blanchard from 1929 to 1938 and from 1945 to 1949, and Pierre Deffontaines in 1948. Geography has indeed been taught at the University of British Columbia since it opened in 1915, in the Department of Geology and Mineralogy, but it was not until 1922 that this became the Department of Geology and Geography and the emphasis long continued to be on the physical side. The first independent Department of Geography was inaugurated at the University of Toronto under Professor Griffith Taylor in 1936; he retired from the Chair in 1951.

A new impetus was given to the study of geography in Canada by the Second World War and the interest in world affairs which has followed it. The

[1] *Year Book of the Association of Pacific Coast Geographers*, 13 (1951) 3–13.

Geography Department at McGill University was inaugurated in 1945 under Dr. G. H. T. Kimble, now Director of the American Geographical Society of New York, and has from the start worked in close association with the Arctic Institute of North America in the study of the Canadian Arctic. Post-graduate studies, for which Canadians had formerly to go to the United States, became general in Canadian universities after 1950 and geography is now included in the curricula of many smaller universities, although there is not always a trained geographer to conduct the classes. Whereas most graduates formerly took up teaching as a career there is now an increasing field of employment in the public service, in particular with the Geographical Branch of the Department of Mines and Technical Surveys under the Directorship of Dr. Wrefford Watson. Here and under the provincial governments, geographers are actively engaged in land-use surveys and on projects for town and country planning. A feature of the application of geography to administrative problems is the summer employment of university personnel.

SUTHERLAND SOUND, SOUTHLAND, NEW ZEALAND

In April and May last year (1951), the Otago Museum, Dunedin, New Zealand, sponsored an expedition to Sutherland Sound, a remote area south of Milford Sound. Its purpose was to investigate the likely occurrence of old Maori sites of archaeological and mineralogical ("greenstone") interest. It has been well known, since the days of Captain Cook, that the Maoris had occupied other fjords to the north and south; but nothing was known in this respect regarding Sutherland Sound which on account of its inaccessibility had had but two or three parties of European visitors since its discovery by Donald Sutherland in 1883. Its likely geological significance lay in the fact that from Milford Sound at Anita Bay southwards extended a belt of rocks containing "greenstone" of the bowenite type of jade (*tangiwai* in Maori), which had been exploited by the Maoris of the district in the early days. It was surmised that this greenstone might be present at Sutherland Sound, and so have been responsible for Maori occupation.

A party of six persons was flown from Lake Te Anau over the coastal mountains to Sutherland Sound by an amphibian aircraft chartered for the purpose. Owing to difficult conditions at the entrance to the Sound, and the fact that the latter really consists of an inner lake basin which drains to the sea *via* sand-flats and a tidal river, it was necessary to establish a base camp at the head of the basin, between Sutherland's reported "Light River" and "Dark River." This was some 9 miles in from the coast, and in consequence the exploratory work, after the departure of the aircraft, could only be carried out in the coastal tract by means of a collapsible canoe. The mountain walls of the inner basin are defended by bluffs and precipitous spurs and in general are so steep that it was practically impossible to traverse the ground on foot. Moreover, the area is covered by dense bush of the typical western coastal rain-forest in a virgin condition, with a notable absence of New Zealand's introduced species which are so prevelant elsewhere.

In spite of an intensive search during ten field days, the only important evidence of early human habitation was discovered at Little Bay at the entrance to the Sound. This was a large dry sea-cave with a boulder-floor raised slightly above sea-level. The whole of the floor-area was divided by a wall-like arrangement of the boulders into compartments of varying size, with a rough fireplace and a small quantity of ash remaining. A few upright sticks, one of which had adze-marks (Maori?) were in place in the outer wall. Refuse, shells, bones and ashes were found amongst the floor boulders, but no artifacts. In the opinion

of Mr. L. Lockerbie, who made the detailed examination, the cave was probably occupied, not less than 100 years ago and possibly at a remoter period, by Maoris or sealers, or both. But more positive data is required to determine exactly who the occupants were, why they were there, and when they lived in the cave.

The absence of "greenstone" in this immediate locality is significant, and indeed the ruling formation was found to be the massive diorite-gneiss that occurs widespread in the region to the north and south. From the air on the return flight, the "greenstone-belt" could be seen by its reddish outcrops to be confined to the coastal strip well north of Sutherland Sound. That there had been recent change of sea-level hereabouts could be seen in the evidence of raised beach and marine-polished cave walls, now some 30 feet above datum.

A topographical sketch-map of the Sutherland Sound basin was made by Mr. W. G. Collett; while all members of the Expedition including Messrs. G. R. and N. R. Murrell and J. A. Mackintosh contributed to studies and collecting in natural history. It was unfortunate that in so isolated and "untouched" a locality time and means prevented more comprehensive investigation of the prolific vegetation and the plentiful, if not abundant, bird-life. N. E. ODELL

AN EXPEDITION TO MOUNT RUWENZORI

An expedition led by Professor W. Q. Kennedy, F.R.S., Professor of Geology in the University of Leeds, left this country on June 23 to spend three months in the neighbourhood of Mount Ruwenzori; among its members is Professor R. F. Peel, one of the two professors of geography at Leeds. The expedition is financed by the Government of Uganda, the Colonial Development and Welfare Funds, the University of Leeds and several learned societies. Its primary object is to prepare a geological map of the area, which is likely to shed new light on the formation of the Great Rift Valley. A preliminary reconnaissance was made by Professor Kennedy last year with the support of this Society and the ground control for an air survey of the mountain was also put in hand last year. Meteorological and glaciological observations on the mountain are a part of this year's programme. The mountain will be ascended from the Belgian side, and the party will be joined by Belgian scientists.

DURHAM UNIVERSITY EXPEDITIONS, 1950

Copies of the typewritten reports of the Durham University Exploration Society's expeditions to Hagavatn in Iceland and to the Engabreen glacier in Norway, undertaken in the summer of 1950, have been presented to this Society's Library. The Hagavatn expedition set out to study the retreat of the Hagafell glacier and other nearby branches of the Langjökull ice-cap in comparison with the Myrdalsjökull area visited by a Durham expedition in 1948 and the earlier work at Hagavatn by a Cambridge party, under J. W. Wright, in 1934. The Norway party had been diverted from its chosen area of study on the Frostisen ice-cap, and its work at Engabreen was of a more general nature, but also with the major emphasis on glacial retreat. Both expeditions carried out a good deal of survey work with theodolite and plane-table and made geological, biological and meteorological observations.

The reports are very full, and well illustrated with maps, diagrams and photographs. They contain much useful information on equipment and organization and reflect the care in working up the results of an expedition which adds so much to their permanent value.

A NEW MAP OF ANCIENT BRITAIN

In the last quarter century the Ordnance Survey has built up a very fine tradition of producing archaeological maps as well as the finest tradition in Europe of putting accurate information about antiquities on its topographical sheets. Some of the archaeological maps have been period maps like the map of Roman Britain; others have been maps of some particular kind of antiquity like megalithic monuments or monastic buildings. Much of this work was the result of the inspiration, industry and great knowledge of field archaeology of O. G. S. Crawford, the Survey's Archaeology Officer for over twenty-five years. Now his successor, C. W. Phillips, another field archaeologist of great experience and repute, begins his career as Archaeology Officer of the Survey with a specialist archaeological map of an entirely different kind—a map of the major visible antiquities of Great Britain older than A.D. 1066.

The new map is at a scale of 1 : 625,000 and is printed in two sheets (south and north) folded, and accompanied by a short introduction and a list of all sites marked on the maps, together with the numbers of the 1-inch sheets on which they will be found and their full National Grid references. The faintly printed modern topographical detail is the base of the map, and the sites of antiquities are boldly marked with symbols which for the pin-pointed sites denote whether they belong to the Palaeolithic, Mesolithic, Neolithic, Bronze, Early Iron, Roman or Dark Ages of our ancient history, and in the case of linear antiquities shows whether they are earthworks, Roman roads, or Roman canals. Some of the more interesting local museums are also marked. The map is essentially a work of reference for the student and general reader interested in archaeology who wants to know where are the archaeological sites he meets in his reading, and for the traveller and holiday maker who is going to a particular region of Britain and wants to know what he can see there in the way of notable ancient things. It will be invaluable for geographers interested in the early cultural landscape of Britain, and most of all to foreign scholars concerned with ancient Britain. Some continental countries like Denmark have excellent guide-maps to their antiquities; and it could be wished that maps like the Danish maps, or like these *Ancient Britain* sheets, existed for France and Spain, for example, and for Ireland. The price of each sheet is 6*s* 9*d*. G. E. D.

THE SOUTH AFRICAN PLACE NAMES COMMITTEE

In December 1936 the Minister of the Interior of the Union of South Africa appointed a "Departmental Committee on the Form and Spelling of Geographical Proper Names." In August 1938 this committee issued a "Provisional List of Geographical Proper Names in the Union of South Africa and in South-West Africa" which proved to be so interesting that it was analysed at some length in the *Journal* (*Geogr. J.* 94 (1939) 45–49). On 8 June 1939 the committee delivered a report (Pretoria, 1939) which included a List A, of names submitted for approval (pp. 14–153) and a List B, of names about which further information was required (pp. 154–160). The work of the Departmental Committee demonstrated so clearly the need for a permanent committee that the Place Names Committee was appointed under the Department of Education, Arts and Science (New Standard Bank Buildings, Pretoria), in 1940. Its terms of reference were: to give final decisions on the names in List B of the Departmental Committee's report, to undertake the gradual correction of the spelling of names in recognized official and unofficial lists, to approve or reject proposals for new names, to consider suggestions for the change or revival of old names, and to compile a list of names for use in the Union.

The permanent committee has now issued its first list of "Official Place

Names in the Union and South West Africa (Approved to end 1948)" (Pretoria, 1951, 376 pp. price £1 5s.). Supplementary lists will be issued in due course. The title-page and text, as in the publications of the earlier Departmental Committee, are in Afrikaans and English, in that order, and it is a pleasure to note that the English (the reviewer cannot judge the Afrikaans) is an example of what official prose ought to be. It is so clear and simple, yet so compact and unpatronizing in tone, that the uninstructed reader will never know what trouble has been taken to enable him to understand why a given name has been spelled in the approved way. In a polyglot country where native names have been refracted through two official languages this must have been a difficult task. The committee's principles for the treatment of its diverse linguistic material are pragmatic rather than dogmatic, and are most reasonable and effective. The expression "double forms" (p. 11) is open to criticism, as there are at least three kinds of repetition to consider: (*a*) Cape Town—Kaapstad; (*b*) Balfour, Cape—Balfour, Transvaal; (*c*) Gong-Gong. Tone rather than stress seems to distinguish a blackbird from a black bird in English (p. 23). And the abbreviations in the third column of the list are nowhere expanded. The inclusion, in subsequent lists, of the native names of important centres, and of the full names of administrative subdivisions, might well be considered.

M. A.

A RALEIGH–HAKLUYT EXHIBITION

During the summer an exhibition has been on view in the King's Library at the British Museum to commemorate the 400th anniversary of the birth of Sir Walter Raleigh (died 1618) and Richard Hakluyt (died 1616), two Elizabethan pioneers of colonial enterprise whose careers touched at many points. The labours of Hakluyt as geographical adviser and editor of 'The principal navigations of the English nation,' and of Raleigh as projector and organizer, are well illustrated by a variety of exhibits including manuscripts, printed books, maps, drawings and seals brought together by Mr. R. A. Skelton, Superintendent of the Map Room.

These record the tragic history of Raleigh's colony of Virginia—the reconnaissance of 1584, Raleigh's seal as "Governor of Virginia 1584," the landing of the first colonists, under Ralph Lane, from Sir Richard Grenville's fleet in 1585 and their repatriation by Drake in 1586, the second settlement, commanded by John White and made in 1587, the frustration of White's efforts to organize a relief expedition in England, and his final return to the now deserted colony in 1590. The water-colour drawings of Indians and natural history subjects by John White, the artist-surveyor of the voyages and almost certainly to be identified with the governor of the second colony, are of particular interest.

Other exhibits besides illustrating Raleigh's later activities deal with the successful plantation of the Virginia colony at Jamestown, with which Hakluyt was associated, in 1606–7; and the achievements of the Elizabethan voyagers in searching for northern, or Arctic, passages to the Far East and in twice circumnavigating the globe. These exemplify Hakluyt's boast that the English "in searching the most opposite corners and quarters of the globe . . . have excelled all the nations and people of the earth."

THE EAST AFRICAN INSTITUTE OF SOCIAL RESEARCH

The third Conference of the Institute took place at Kampala from 1 to 9 January 1952. It took the form of a small Fellows' meeting which was mainly given to the discussion of detailed comparative work on the social and economic structure of the inter-lacustrine Bantu and the planning of joint publications in this field.

Discussions were held on the kinship, territorial and political organization of the following groups: Uganda—Ganda (A. B. Mukwaya), Nyoro (J. Beattie), Soga (L. A. Fallers), Toro (B. K. Taylor); Tanganyika—Ha (J. Scherer), Haya (P. Reining), Zinza (J. W. Tyler). A scheme for the comparative study of political systems outlined by the Director was also discussed as well as a paper by Dr. K. Wachsmann on traditions of tribal migration among the inter-lacustrine Bantu. Two papers on tribes in Kenya were also read—"Social structure of the Boran" by P. T. W. Baxter and "Marriage among the Kikuyu" by J. Fisher.

Professor F. Lorimer of the University of Washington was present at one session and outlined a scheme for the collection of demographic data in East Africa. He was anxious to acquire additional information on maternity histories in areas of particularly low or particularly high fertility according to the 1948 census, and suggested forms of village survey that might be conducted to this end.

THE VOLGA–DON CANAL

It was reported in *The Times* of 2 June 1952 that the progress of the construction of the Volga–Don canal had reached a stage at which the waters of the two rivers mingled in the canal on May 31. The canal, which is about 63 miles long and joins Kalach on the Don with Stalingrad on the Volga, was described in Academician A. A. Grigoryev's paper in the last issue of the *Journal* (p. 172). Its construction was interrupted by the war and it is scheduled for completion in 1952.

OBITUARY

MILDRED CABLE

Miss Mildred Cable, who recently died at the age of seventy-three, was an English missionary of world-wide renown and a woman of exceptional qualities and abilities. In girlhood she shared with her father the delights of Continental travel with its sightseeing and luxurious hotels. She qualified in medicine but renounced a degree lest it should lead her to a vocation confined to hospital wards. She was associated with a famous London preacher in his class work and, with the highest ideals of Christian service, she cultivated self discipline. She was still very young when she joined Miss French, a recuperating victim of ferocious Boxer cruelties, at a then recently devastated station of the China Inland Mission in Shansi. With Francesca French who came out later, the famous trio was complete.

For twenty years they lived in Chinese style in intimate touch with people of every class, and developed a fully established Christian centre at Hwochow in Shansi. Then followed fifteen years spent as nomads in the far north-west. Five times they traversed the whole length of the Gobi desert, and four times undertook the six weeks' journey from Suchow to Urumchi. They visited Yümen, Ansihchow, and the region around the Edsingol on several occasions and a final journey ended at Novosibirsk. They did not follow trade routes only, but searching out innumerable bypaths, they reached hidden oases and isolated dwellings, their only headquarters and home a cart or tent, a space in an inn, or anywhere to spread their bed-rolls. At the worst the open air sufficed, or even a cave littered with human bones.

This leisurely travel led to happy relations with carters, camel men, pilgrims and people of unknown tribes from "off the map"; and nothing human escaped Mildred Cable's attention. She noticed all their doings and sayings, in inn yards or temple courts, in villages or on the roads. Many tribes were met with, and visits paid to lamas, shahs, khans and other notables in hitherto unexplored temples, palaces and head-men's quarters. Yet, on her rare reappearances in England after long years of isolation and strenuous travel, Mildred Cable took her place as if fresh from some brief holiday, up to date with literature and current affairs to a remarkable degree.

In 1943 she delivered the Fifth Asia Lecture (Dickson Foundation) to the Society, on "The bazaars of Tangut and the trade routes of Dzungaria" which described her discovery of the new Caves of the Thousand Buddhas; a discovery comparable only in importance to Sir Aurel Stein's discovery of the decorated caves at Tunhwang, and of great importance in the history of Eastern art. In later years she travelled extensively for the Bible Society, covering India and Australasia and making a thorough survey of Brazil. Everywhere the same rare abilities were displayed, in lectures, receptions, visits and functions, and in her definite Christian witness wherever she went. Friends who were favoured with her journal-letters enjoyed a wide range of information interestingly set forth, and until the "Iron Curtain" is removed, her books on travel in Central Asia will remain unsurpassed in their particular field. R. G.

HUGO HASSINGER

Only six months after the sudden death of Johann Sölch, Austrian geography has suffered another tragic loss. On 13 March 1952 Dr. Hugo Hassinger, Emeritus Professor of Vienna University, died as a result of a traffic accident. His life ended where it had begun on 8 November 1877, in Vienna, the city which furnishes the key to an important part of his work—the geographical treatment of this European jewel and the region which it crowns: Donau-Mitteleuropa. Even the very term was coined by him.

Hugo Hassinger received his education at Vienna, and it was here that he followed his university studies, taking his doctorate in 1902 as a pupil of A. Penck. After teaching at grammar schools he was appointed "Dozent" at Vienna University in 1914; at the end of the Great War he was offered the Chair of Geography at Basel University. In 1927 he went from there as Professor of Geography to the University of Freiburg i. Br., but in 1931 returned to his Alma Mater to take over one of the two Chairs of geography, which he held until his retirement in 1950.

As a pupil of Penck his interests were first directed towards geomorphology. It was however in human geography in its widest sense and also in regional geography, especially of Danubian Middle Europe, that he made his greatest contributions. In these fields, it is fair to say, he ranked first among all German-speaking geographers of his time, and his "Geography of man"[1] is still the most complete treatment of the subject in the German language. His other main works are 'Geographische Grundlagen der Geschichte' (1931) and 'Die Tschechoslowakei' (1925). He wrote numerous shorter papers, articles and monographs, some of which, like his essay on the geographical character of Middle Europe,[2] have already become classics. After the last war he undertook

[1] "Die Geographie des Menschen," *Handbuch der Geographischen Wissenschaft*, vol. 2, pp. 167–542 (1933–37).

[2] "Das geographische Wesen Mitteleuropas," *Mitteilungen der Geogr. Gesellschaft, Wien*, 60 (1917) 437–493.

a study of Austrian exploration, 'Österreichs Anteil an der Erforschung der Erde' (1949).

Many honours were conferred on him. He was a member of the Österreichische Akademie der Wissenschaften, corresponding member of the Akademien der Wissenschaften of Berlin, Bucharest, Halle, München and Prague and of the Deutsche Akademie für Städtebau und Landesplanung. In addition he was honorary member of various learned societies, notably of the Geographische Gesellschaft in Wien, of which he was president from 1936 until 1950.

A tragic accident put a sudden end to a life which was still yielding a rich harvest. The wealth of his work assures him an honourable and lasting memory, but those who had the opportunity of meeting him will remember Professor Hassinger not only as a great scholar but as a great person, modest and kind.

KARL A. SINNHUBER

CORRESPONDENCE

AN EARLIER ERUPTION OF GOENOENG KOMBANG

The account in the March issue of the *Journal* (page 103) of the eruption of the Kelut brings vividly to mind a visit which I made to Blitar shortly after the last eruption in 1919. Blitar suffered severely on this occasion, being directly in the path of one of the three main mud-streams. A detailed account of my visit appeared in a well known Far Eastern journal at the time. Many former tourists will recall the fine view of the volcano which is to be obtained at sunrise from Tosari (6000 feet) on any fine and clear morning—its line of jagged peaks lying away beyond and between the Kawi and Ardjoeno. I made my visit from Soerabaia via the south coast.

The first mud-stream was crossed near Wlingi, at a point about 5 kilometres beyond this small place, and cut rail and road communication from the east. The next stream was that which descended in a south-south-west direction on Blitar (170 kilometres from Soerabaia), some 12 kilometres farther on. The third stream was far and away the largest and most destructive. It took a track to the north-west of Blitar and extended to a distance of about 40 kilometres, and with an average width of about 7 kilometres. Whole villages in the track of this stream were wiped out, including the native centre of Oedan Awoe (*oedan*=rain; *awoe*=ashes), which had suffered severely from previous eruptions.

With reference to Blitar, I quote from a copy of my account written at the time: "In Blitar itself there are still many evidences of the disaster. Only part of the town was disastrously affected; but that, the centre, which experienced the full force of a stream which had covered the distance (about 25 kilometres) from the crater lake in about half an hour. The force of the stream carried away the prison walls but these have already been rebuilt. In one place near the prison a mud-level mark about seven feet above the road is to be noted. The railway station, government offices, and main native quarter of the town all suffered badly. In this part of the town there are still large banks of stones, dried olive-greenish grey mud, boulders, and other debris, which despite the energy and thoroughness of our Dutch friends it has not yet been possible to clear away. The larger vegetation has apparently suffered little in the town. I understand

that the temperature varied very considerably, and the mud was only hot enough to scald near the large hot boulders which came down with it. In one instance I am informed, a European was carried away by the stream for a distance of about a third of a mile, yet survived."

The Dutch engineers had a plan for periodically draining the crater lake after this last eruption, but I do not know if it had been completed before the Japanese occupation as it is now many years since my last visit to the island. I note however that this time there was apparently no devastating mud-stream as on previous occasions.

P. W. MAY

5 *May* 1952

GREEN SKY

A green or greenish sky, due to an anomalous degree of that selective scattering of light by the air which ordinarily produces blue sky, is commonly seen towards the horizon, especially near sunset or sunrise. Since ground colours are but little reflected from a clear sky, the fundamental factor in its causation must be the physical constitution of the air mass as to density, water vapour and dust. I agree with Mr. Thomas in his letter in the last issue of the *Journal* that polar air favours the phenomenon, but green patches are in fact quite usual at sunset, particularly on the opposite eastern horizon. On the evening of 7 June 1952, in clear polar air preceding rain on the morrow, I observed from the northern suburban heights a remarkable band of bright green over London, to the south-east (opposite to the June sunset) above a dark sheet of stratus cloud capped with small cumulus tinged red and orange by the slanting rays.

Nevertheless, it is fairly certain that the geographical terrain also affects the occurrence of green sky. It is pointed out by M. Minnaert in his 'Light and colour in the open air' that a green colouration often follows a fall of snow, apparently because of the selective scattering of sunlight reflected from its surface. Hence it would seem that polar explorers must be familiar with conspicuous green sky hues, quite apart from any association of this colour with auroral displays. And if, as one suspects, green sky appears with special frequency over the oceans, even in low latitudes, it is probably connected with the scattering of sunlight reflected from the sea surface rather than with the glaucous tint of the sea itself.

It should however be remembered that the appreciation by the human eye of atmospheric tones and colours is largely influenced, as landscape painters are well aware, by abrupt contrasts of light and shade. Thus I generally notice that the green hue is enhanced when seen within rifts in the clouds or along their margins, just as a blue sky takes on a deeper tint near the edges of clouds, buildings, trees and the like.

L. C. W. BONACINA

24 *June* 1952.

CONTOURS ON TOPOGRAPHICAL MAPS

In the excellent note on "Contours on topographical maps" which appeared in the *Journal* for June 1952, it is correctly stated that a change in the direction of having more contours, closer together, on the topographical maps of the Ordnance Survey, "was recommended in general terms by the Davidson Committee." The Final Report of this Committee was signed and published in 1938, and this particular recommendation will be found on page 17.

The Committee, which did some good work and issued a generally valuable report, was not well informed on this matter. The fact is that some twenty years before the publication of the *Report*, after the conclusion of the First World

War, the Ordnance Survey had already inserted approximate contours at 50-foot intervals on the 1-inch map (Popular Edition). These contours still remain on the maps. They were inserted between the 100-foot instrumental contours of former editions, and were based partly on interpolation, and partly on such "spot heights" as were available. And, indeed, many years before this date it had been pointed out, in the official Text Book, that the best interval for contours in normal European country, for a 1-inch map, was 50 feet. It will be seen that the *Report* of 1938 may have given an incorrect impression, as regards the 1-inch map, to those who do not know the facts. C. F. ARDEN-CLOSE

Winchester, 1 July 1952.

GEOGRAPHY IN THE SERVICE OF MANKIND

Letters are still reaching me from geographers in various parts of the world on the subject of the employment of geographers in industry, commerce, administration and the Public Services. Some University geographers have gone to the trouble of analysing the records of Honours School graduates in Geography after leaving their Universities (in a similar manner to the analysis to which your correspondent Mr. T. W. Freeman refers in his letter in the *Journal* for June) and point out that quite a number of these geographers did, in fact, take up appointments outside the teaching profession. I am grateful to these correspondents and have been greatly interested in their letters but I would point out that none of these analyses has proved me to have been wrong in my contention that "except in very rare instances it is useless for the geographer to seek posts in industry, commerce, administration or the Services *as a geographer*."

My correspondents have been at pains to draw my attention to the number of geographers earning their livings outside the teaching profession but only in two or three instances have they produced evidence that these geographers are serving *as geographers*. In by far the majority of cases it is clear that their work does not utilize their geographical knowledge to any greater extent than it utilizes their knowledge of other subjects: in other words they got their jobs on the strength of their university education generally and not because they had specialized in geography. Except for the two or three cases referred to, these men and women are using their geographical knowledge in their jobs no more than they are using their ability to read, to write, to do sums or to think logically.

The evidence which has come my way since I delivered my paper at Edinburgh last September all goes to support Professor Stamp's contention that selectors and employers are becoming more favourably disposed to applicants with a geographical degree, not so much because of their special geographical knowledge but because the type of people who choose to read Geography at the Universities impress them as being the sort of people they want. If this is true then it is a very interesting fact.

I think I have accomplished what I set out to do when I wrote and delivered the paper at Edinburgh. I seem to have stirred up some interest in this important matter and it is now my hope that some of those many interested persons will follow up these clues and seize any opportunities which may exist for establishing the trained geographer firmly in the public esteem.

3 *July* 1952 E. O. GIFFARD

MEETINGS: SESSION 1951–52

Twentieth Meeting, 5 May 1952. Dr. K. S. Sandford in the Chair

Paper: Some problems of Libyan geography. By W. B. Fisher

Twenty-first Meeting, 12 May 1952. Dr. K. S. Sandford in the Chair

Papers: Spitsbergen, 1951. A symposium of three papers on recent university expeditions

Twenty-second Meeting, 19 May 1952. The President in the Chair

Elections to Fellowship: Alan Ferguson Airey; E. Oluĩemi Ayoola, B.A.; John Brown; Lieut.-Colonel W. A. C. Collingwood, M.B.E.; Edward Cothey; Allan Black Cunningham, M.A.; The Rev. Claude H. Curtis; Miss Susan Eaton; Thomas L. Graham; Paul Hardy; The Rev. A. Powell Hutchison; Dr. Abdul Hamid Khan, M.A., B.T.; Miss Dorothy Lee; Percy Cromwell Main; Nigel James B. Neilson; Ronald R. Philp; Eric Alfred B. Pratt; Major Peter T. Prentice; Ronald Rees; Major Louis M. Sebert; William Reginald Slack; Lieut.-Commander Frank S. Styles; Robert N. Thompson; Burt Kerr Todd; Rayner Stephens Unwin, M.A.; Miss Barbara M. Wadie, B.A.; Mrs. Dorothy L. Wolfe; Max Holbrook Wood

Transferred from Associate Membership: John Philip Attree; Lieut. Peter Hollis Clayton; Brian Fullerton; K. J. Green; Lieut. I. A. D. Gordon; Miss Mavis Pollard; Alfred A. Rapoport; Miss Elizabeth Shepherd; Miss Kathleen Stainsby

Elections to Associate Membership: Miss Jean Maxwell; Frank Walter Steele; Miss Margaret Rosemary Stewart

Paper: Explorations in Arnhem Land. By Donald Thomson

Twenty-third Meeting, 26 May 1952

Films: Patagonian profile. Colour films with a commentary by Dr. Maynard Miller

Twenty-fourth Meeting, 9 June 1952. The President in the Chair

Elections to Fellowship: Maneklal M. Acharya, B.A.; Alastair H. F. Atkinson; Harold Brewster; The Rev. George W. J. Burrows; Robert H. C. Carr-Gregg, M.A.; Miss Jean Mary Clark; Mrs. Rosemary G. Cocking, B.A.; Camilo Maria do Carmo Freire Corte-Real; Miss Margaret H. Cunningham, B.A.; Walter W. Deshler; Dr. Fred E. Dohrs; The Rev. William A. Dunlap, B.A.; Stephen Wilbraham Ford; Dr. Andrew Gih; The Rev. Alan E. Hutchings; R. D. B. Jayasekera, B.SC.; John H. K. Jefferson; A. Wallis Johnson; Gerald James Jones; H. Dennis Jones; Quentin Keynes; John A. C. King; Miss Kathleen M. Lightbody; Michael D. MacCarthy; Miss Ethel Mannin; F./O. John J. Miller, R.A.F.; Arthur James Millington; Frank Nevitt; Mrs. Elizabeth Nicholas; Peter W. Parnwell; Miss Nona Elliot Paterson; John Phillipson; Eli Kirk Price; Gerald T. Rimmington; Barnabas Russell; Miss Ella St. John; Major P. V. Smillie, R.E.M.E.; Miss Lily E. Staples; Cyril Sweett; The Rev. George H. Vorsheim, M.A., B.SC.; Miss Joyce Wace; Thomas Peter Wells; Robert Edward Yorke, M.A.; John Leslie T. Young, B.A.

Transferred from Associate Membership: E. F. Grimwood

Elections to Associate Membership: Derek R. Diamond; Geoffrey G. F. Gilham; Charles Roger Middleton; Colin E. B. Steers

Paper: Voyage of *Discovery II*, 1950-51. By Dr. H. F. P. Herdman.

ANNUAL GENERAL MEETING, 23 June 1952. The PRESIDENT, Mr. J. M. WORDIE, in the Chair

The Hon. SECRETARY, Mr. Leonard Brooks, read the Minutes of the Annual General Meeting held on 25 June 1951, and these were confirmed and signed by the President.

The PRESIDENT then delivered his Presidential Address which is printed at pages 245–50.

The PRESIDENT: We now come to the presentation of the Medals and Awards. The Founder's Medal, with the approval of Her Majesty the Queen, has been awarded to Mr. H. W. Tilman. Mr. Tilman has a long record of mountain exploration in Africa and Asia and he has described his experiences in a number of well-known books. In Africa he has climbed on Mount Kenya, Kilimanjaro and Ruwenzori. His main achievements have however been in Central Asia and the Himalaya. In addition to taking part in the Mount Everest expedition of 1935 and leading the expedition of 1938, he made the first completed ascent of Nanda Devi in 1936, and has journeyed extensively in Sinkiang and in Nepal. He has penetrated to the unexplored Indo-Tibetan area east of Bhutan, and brought back a valuable map of the region. Mr. Tilman is the leading exponent of the small party, travelling light, and it is in recognition of his enterprise, leadership and success in this respect that this award is made.

Mr. Tilman is abroad and the Medal is being received on his behalf by Professor G. I. Finch, himself a most distinguished climber on Mount Everest and elsewhere.

Professor G. I. FINCH: I want to thank you, Mr. President, on behalf of Mr. Tilman who cannot be here because, as you have said, he is abroad at the moment. And might I add a word or two and say how pleased I am that you have made this award. I do not think a better recipient could have been chosen. You, sir, have outlined some of the great achievements of Mr. Tilman and I would like to add that he has a distinguished geographical career in another sense. He has a distinguished military career and his geographical work was done under extraordinarily difficult conditions both in Albania and in Northern Italy when he was dropped behind the lines and there did wonderful work which gained some recognition in that he was awarded the D.S.O. I happen to have been in Italy in 1951 and I found Tilman's name was a household word in the northern parts; he was known to almost everybody there; he had become, indeed, a legendary figure. I feel sure therefore that this award will give pleasure not only to us all in England but also to his old comrades in the resistance movement in northern Italy and perhaps also, if the knowledge of it is allowed to get there, to his old friends in Albania.

The PRESIDENT: Her Majesty the Queen has approved the award of the Patron's Medal to M. Paul-Émile Victor for his contributions to polar exploration, including his geophysical investigations of the Greenland ice-cap. Before the war M. Victor initiated French exploration and research in Greenland on a large and important scale. After the war he resumed and developed his work, which had begun with a crossing of Greenland in 1936–37. The station which he set up in the centre of the ice-cap has been maintained for three years, and the soundings carried out have yielded unexpected data on the thickness and nature of the ice-cap of southern Greenland. His interests have also extended to the Antarctic, for his organization in Paris is responsible for the French expedition under André Liotard which is now in its third winter in Adélie Land. The award of this medal testifies to our high appreciation of M. Victor's long record of exploration and discovery which has rarely been equalled in the history of Arctic exploration.

M. PAUL-ÉMILE VICTOR: I wish I had the right to thank you on my behalf and on my behalf only, but since I started my polar work in 1934 there have been about 150 others who have participated in my explorations, so that I share this Medal with 150 of my comrades and thus the part that comes to me is about 150 times less than it seems and the thanks I am expressing are just about 150 times bigger. Multiply by 150 what I have said and you will have full thanks to you for this honour.

The PRESIDENT: The Council have awarded the Murchison Grant to Mr. W. D. C. Wiggins for his contributions to cartography. I think many here may remember Mr. Wiggins as Colonel Wiggins throughout the war and I find it difficult to adopt a civil form of address. Mr. Wiggins is Deputy Director of Colonial Surveys, and has been responsible for the general design of the maps issued by the Directorate. These include many new features which contribute to clarity, rapid production and greater usefulness, and his work is therefore making a most important contribution to the development of our colonial territories.

Mr. W. D. C. WIGGINS: I must express my very great appreciation of the honour you have done me. I cannot think why I should have been singled out because the maps we produce are the production of the whole Directorate. So once again you hear me say, as others have already said, that it is really the whole Directorate, the whole team, that should be honoured. I am the lucky one who gets the honour. It is a pity that our maps have to be so severely "utility." We have two great shortages and, like poor relations, they seem to be with us all the time: they are time and man-power. When we can get rid of them we can produce some more pleasing maps, and I hope that will not be in the too far distant future. Thank you.

The PRESIDENT: Dr. H. F. P. Herdman, to whom the Back Grant is awarded, is one of the original staff of the Discovery Committee. He sailed in R.R.S. *Discovery* in 1925–27, and has made no less than four voyages in *Discovery II*, his latest being in 1950–51 when he was senior scientific officer in charge of the research programme. Dr. Herdman is an expert on the natural history of sea-ice. He has also made a special study of oceanic soundings, and has thus played a leading part in extending our knowledge of the Southern Ocean and also of the Indian Ocean.

Dr. H. F. P. HERDMAN: I feel very honoured to be awarded the Back Grant by the Council but I, like my two predecessors here, feel it is rather that I have been singled out for something which should be awarded to a team. The *Discovery* work has been going on for a great many years, and it is the general build-up which has produced the results which I have been lucky enough to cash in on. At the same time I feel that the special staff who joined us after the war, and had not perhaps had a great deal of experience, were very much more help to me than they probably realized; they made me do a little more work when I might have sat back and been more idle. I thank you again for the Award.

The PRESIDENT: The Cuthbert Peak Grant is awarded to Mr. P. H. T. Beckett for his geographical work as leader of the Oxford University Expedition to Persia in 1950, the results of which he described to the Society at one of our meetings. Mr. Beckett is now Chairman of the Oxford University Exploration Club, and we take this opportunity of showing our appreciation of his enthusiasm and hard work in encouraging interest in exploration among the younger members of his University.

Mr. P. H. T. BECKETT: University expeditions are perhaps characterized by the chaos they leave around and behind them as they proceed to the scene of

work. But they try to carry out what they attempt in a very short time and their work needs to be carefully fitted together afterwards. So I think I can say, in thanking you, that I am here to represent not only the four members of the University expedition to Persia but a large number of members of the Oxford Exploration Club.

The PRESIDENT: The Gill Memorial is awarded to Captain R. S. Webb for his study on Basuto place-names. In pursuance of this objective he has travelled more than 10,000 miles; and the results of many years' work have now been published, at Captain Webb's own expense, as a 'Gazetteer of Basutoland,' a publication which has been warmly commended by the Permanent Committee on Geographical Names. In the nature of the case this has been single-handed work. Captain Webb is away in South Africa and the award is being received on his behalf this afternoon by Mr. Aurousseau, the Secretary of the Permanent Committee on Geographical Names.

Mr. AUROUSSEAU: I am very pleased, sir, to thank you on behalf of Captain Webb, whom I have never met but with whom I have corresponded over the past six years, mainly concerning his work in Basutoland. That has been very long lone-hand work, entirely done by his own enterprise and at his own expense, even to the printing of the 'Gazetteer of Basutoland.' Captain Webb has sent to the Society a short statement of thanks for this award and I think he would be disappointed if I did not read it to you.

Mr. Aurousseau then read the following statement:

"Mr. President, My Lords, Ladies and Gentlemen,—It is, for me, a misfortune that I am unable to stand before you in person today.

"I thank you, with a lively sincerity, for the honour awarded to my work; and would assure you that this mark of approval will be appreciated by many persons in Basutoland. The first draft of the Gazetteer has been well received there; and is already greatly improved, as a result of the cooperation of the Basuto.

"The changes of habit wrought in me by long absence from the city of my birth have but strengthened my attachment to London. But you will hardly need my humble assurances of loyalty, nor reassurance of the fidelity of the Basuto. The People of Moshesh are loyal to tradition, remembering the efforts of Napier, Maitland and Grey; remembering their friends and protectors, Joseph Millerd, Orpen, Lagden and Arden Clarke.

"The Basuto have implicit faith in the continuance of your protection; and many of them, in remote and lovely valleys, can scarcely sense the changing world that has seen the revered Great Queen Victoria succeeded by our Gracious Queen Elizabeth."

The PRESIDENT than appointed Brigadier H. A. Jolly de Lotbinière and Mr. Gordon de Q. Robin to act as scrutineers of the ballot for the Council and Officers for the ensuing year. While the ballot was in progress the President invited questions or comments on the Annual Report which had been circulated to Fellows.

Captain PERRY SHAW: I notice in regard to Council elections that there is only one lady member of Council. As there are a large number of lady Fellows of the Society, that does not seem very helpful. I respectfully submit that there should be a greater representation of lady Fellows.

The PRESIDENT: We have two members on the Council who are ladies, Dr. E. J. Lindgren who remains a member of Council and Miss J. B. Mitchell who comes off and may be succeeded by Dr. Alice Garnett if the ballot comes out as anticipated.

Miss KELLY: Can covenants for subscriptions be made compulsory, in which

case everybody helps everybody else and it may not be necessary to raise the subscription.

The Hon. SECRETARY, Mr. Leonard Brooks: There cannot be a compulsory covenant. If a Fellow uses geography in the course of his work his subscription may be treated as part of his expenses; also, anyone who covenants must, at some stage, pay the full rate of tax.

Mr. W. CARTER: Would it be a useful step to send a circular out to Fellows explaining the need for more income for the Society and asking how many would be prepared to covenant? You said, Mr. President, that the intention was to hold a Special Meeting on the subject in the autumn. If a circular were sent out now you would ascertain by that time how many Fellows would be prepared to covenant, and could even calculate how much income would be produced by covenants promised. It might then be possible to reconsider the proposal to increase the subscription.

The Hon. SECRETARY: It seems to be very clear that we are running into some difficulty in regard to covenants. Papers explaining everything about covenanting were ready for circulation months ago, but we have not yet obtained permission to covenant from the Inland Revenue Authorities. We are held up because of that. The difficulty is that from the latest information—and of course we have obtained counsel's opinion on all the action we have taken in regard to covenanting—we gather that the whole question of covenanting is under review, and the officials of the Inland Revenue cannot tell us yet whether or not we shall be allowed to covenant. If we were certain of that, the papers would be issued very quickly indeed. And if we were certain that we could raise enough money by covenanting without having to raise the subscription, we should do so, and this is what I personally have hoped for all along. We have a large number of young Fellows; the biggest single component of our Fellowship comprises geography teachers in schools. I think you know what their salaries are and you will realize that they cannot covenant unless they pay the full rate of tax at some stage. It is going to be difficult. Nevertheless, we shall go ahead and pursue the question of covenanting as far as possible.

Mrs. THEODORA PATTERSON: I have been a Fellow of this Society for about thirty years and I wish you had more women speakers. Very few women will attempt to speak unless they can really do so, and if they do speak they are, as a rule, a great success. I suggest you have more women speakers in your programme.

The PRESIDENT: We will try to meet your wishes. Would you be so good as to send the names of possible ladies to give evening lectures? Would you let us know if at any time there is some particular person you would like to have considered?

Mrs. PATTERSON: Mrs. Chapman has given lectures to the Society. At any time I am prepared to give lectures on my own travels. I have excellent slides. But that is beside the point. There are others I can let you know of.

The Annual Report, with the balance sheet, was unanimously adopted.

The scrutineers reported that the candidates proposed for Council and Officers for the ensuing year had been elected.

Sir HARRY LINDSAY: Before we part, it will be a great honour and pleasure to me to propose a resolution which is not down on the agenda; it is completely informal; it is not even addressed to the Chair, and that is probably out of order, but I am sure it will command your whole-hearted and single-minded approval.

The task of our President is by no means an easy one. He lives, if I may say so from experience, a sort of double life. He is in one capacity immured in

his office—you will find the den between the two Map Rooms—or else in the Council room, and he is also the President whom we know on the platform in this hall. Mr. Wordie has won all our hearts by the way in which he has filled the post of President during the past year. He is Master of the second largest College in Cambridge, St. John's College, but I think he commends himself most to you for his explorations in the Arctic and Antarctic and for the wonderful way in which he has presided over our meetings. The resolution which I put to you is to pass to Mr. Wordie a very hearty vote of thanks indeed for his past year's work, and our best wishes for the ensuing year.

The PRESIDENT: Thank you very much, ladies and gentlemen, for the way in which you have received Sir Harry Lindsay's proposal.

The proceedings then terminated.

THE ANNIVERSARY DINNER

The Anniversary Dinner was held at the Hyde Park Hotel on Monday 23 June 1952.

Mr. J. M. Wordie (President of the Society) and Mrs. Wordie received the company, which included among the guests of the Society, the Rt. Honble. R. A. and Mrs. Butler, Sir George Thomson, M. and Mme. Jean Le Roy, the President of the Geological Society and Mrs. Lees, Professor and Mrs. C. A. Cotton, Professor and Mrs. G. I. Finch, M. and Mme. Paul-Émile Victor, Mr. and Mrs. W. D. C. Wiggins, Dr. and Mrs. H. F. P. Herdman and Mr. P. H. T. Beckett.

After the Loyal Toasts Sir GEORGE THOMSON said: I am credibly informed by one of the Society's officers that its founders were partly stimulated in their action by the fact that the Royal Society of London was inclined to cold-shoulder the science of geography. Well, as not infrequently happens, good sprang from evil, but it was none the less an ungrateful attitude for it may, I think, be claimed that modern science owes its origin to geographical discovery.

Last week I stood in the Court of a Cambridge College that is celebrating its Sexcentenary and, looking at the walls which have stood for so long, one could not help thinking of the attitude of mind of the men who built them. It was a very limited attitude in many respects. It was certainly limited geographically to, I suppose—I am no historian of geography—Western Europe, the Mediterranean, and probably part of the Nearer East. It is true that Marco Polo had visited China and returned with wonderful stories, but all he received for his discoveries was the name of "Mr. Million."

This limitation in space was paralleled by limitations in scientific imagination. The old civilizations of Egypt, Babylon and Greece did indeed advance astronomy to a very considerable degree but in the other sciences they made surprisingly little progress. I think the reason is summed up in the word "mundane." They regarded the things of the world as of the earth earthy, unworthy of the serious attention of a great intellect. What these men lacked was not ability, not even the over-praised scientific method, but the realization that there were, and are, exciting and important things always waiting to be discovered. Ultimately geography showed those men the way to discovery, and it did so in the person of Prince Henry the Navigator. Whatever the Marxist may say, it is people that really matter in history. Cleopatra's nose is more important than the Egyptian grain trade and Helen had more to do with the fall of Troy than had the need to open up the Euxine to early traders.

Henry, I believe, was the founder of modern science. He did not himself

navigate—not that he was lacking in courage—but he was the Royal Geographical Society of his age, providing science, enthusiasm and money for his captains who worked their way down the African coast in their attempt to extend knowledge of the western world. At first it was a slow process for they had to fight not only against the difficulties of Nature but against their own superstitions. Yet before Henry died they had reached Cape Bojador, Cape Blanco and Sierra Leone. The movement once started was irresistible. It was a matter of course that the exploration should continue; that the Cape of Good Hope and India should be reached, and once that had happened it was hardly necessary for Columbus to sail across the Atlantic, for Brazil would undoubtedly have been discovered by ships making for the Cape.

These men had made the most important discovery it is possible to make: that there were exciting things to be found in the world. Thus they stimulated science in two ways; first, by making navigation important they stimulated science; in particular the study of the compass. This brings to mind a man to whom I must give a word, Gilbert of Colchester, if only because he was a Fellow of the College at Cambridge which has recently honoured itself by appointing your President its Master. Gilbert, who lived in the reign of Queen Elizabeth, wrote what I think is the first really scientific text-book in English and probably in any language; his book on the magnet is a model of how to conduct a scientific experiment.

But the greatest discovery was that among the phenomena "beneath the moon" there were many well worthy of the most intelligent man's most careful attention. Science has learned its lesson, but Geography still calls to adventures of the body and of the mind. How well the call can still be answered is shown by the career of your President in the Antarctic and in the Arctic. And he is soon going to the United States of America to receive the Daly Medal from the Society which is your American counterpart; I am sure no medal could ever give more satisfaction both to you and to those who have given it.

Long may Mr. Wordie flourish and guide your affairs and those of his College. He will, I know, advise and help the Society in its work without neglecting the College over which he is from now on to preside. Long, too, may the Royal Geographical Society endure and flourish to show the world that men of our race can combine the virtue of courage and enterprise with the advancement of learning.

I give you the toast of the Society, coupled with the name of your President.

The Rt. Hon. R. A. BUTLER, M.P. (Chancellor of the Exchequer): It is a great honour to be asked, however shortly, to support this toast. I am glad particularly to support the Master Elect of Corpus Christi. I journeyed to Cambridge last week-end and had the honour of being elected into an Honorary Fellowship of his future College. I felt that a great honour and I also think it an honour to support your President on this occasion. Sir George Thomson looks somewhat flushed, probably due to his recent diet of steer from Texas, of which he partook freely only a short time ago. I congratulate the distinguished proposer of the toast and I also congratulate Corpus Christi of which I was once a Fellow upon their great sense of publicity. I hope that under his Mastership the College may go from strength to strength.

I feel moved to support this toast because I understand from your Director and Secretary, and in fact I had registered it myself, that it is twenty-one years since I was first a Fellow of the Royal Geographical Society. That is quite a long time to be a Fellow of this very memorable institution. I have many friends, I am glad to say, here to-night. The only difference between them and me is that I have no courage or power of adventure, and they have all the

courage and all the adventure. I do congratulate the Society upon reviving its Dinner and I feel you deserve every support in keeping the work of your Society going because of the wonderful support the Society gives to the adventure of exploration which in our generation, I am sure, has new and fresh fields to conquer as Sir George Thomson has shown that it had in the past.

I am told that I have to solve all sorts of terrible financial and economic problems, and I am told that I have no courage and that when we took over this job we had a number of skeletons in the cupboard. I know of a cupboard in which there are two skeletons—who spoke to each other as follows: "If we had any guts, we would get out of this under our own exertions." I think that is true not only of the task I am trying to do for the country but of the Royal Geographical Society. If you have flesh and blood, to put it in more appropriate terms courage and good heart, you can contribute to a modern age as much as the explorers and adventurers of old contributed in their day. I feel certain that the traditions of your Society will be maintained under your worthy President and that you who are associated with the Society will carry on that tradition with fresh inspiration for the future.

The PRESIDENT (Mr. J. M. WORDIE), in responding, said: First, I should like to thank Sir George Thomson and Mr. Butler for the very kind way in which they have proposed the toast of the Society. It was pleasant to be reminded once more of Prince Henry the Navigator and, as Sir George Thomson said, William Gilbert; there he struck the right chord so far as my knowledge is concerned, though I fear that the name of Gilbert is now almost forgotten. Nevertheless, when he died a contemporary poet said that the name of William Gilbert of Colchester would always be remembered till lodestones ceased to draw. The magnet still functions unless Sir George Thomson and his fellow physicists have destroyed it in some subtle way, but Gilbert's name is almost forgotten. He was a very great man and the first scientist who made physical science other than a black art.

To-night you have probably realized is a Corpus Christi night. That College, one of the greatest and most progressive in Cambridge, has just celebrated its six hundredth Anniversary. Sir George Thomson was a little reticent. When he spoke of wandering about the court of an old College he was describing a College in which he himself will now preside. And six hundred years takes you back a century, perhaps two centuries, before Prince Henry the Navigator. I come from a College which is comparatively young and therefore feel that I can say how much I appreciate the presence here of both Sir George Thomson and of an Honorary Fellow of his College, Mr. Butler.

This afternoon in the Presidential Address one had to be factual, but there are one or two matters to which I should like to refer now in somewhat lighter vein. We hope to bring out a new edition of 'Hints to travellers,' but it is a very difficult book to produce, particularly with the present Volume II, which was a labour of love on the part of its editor. He produced what I think is a brilliant book; he inveigled all the explorers of his time, some twenty or thirty of them, down to his country cottage and then proceeded to pick their brains. I wonder whether the travellers whose wisecracks are set down in print in that book remember what they said? Does Frances Rodd remember what he said about "Bag and Baggage"? He has taken evasive action and altered his name! Does Mr. St.John Philby remember what he said about camels, because there were not many experts to speak about them, except Lord Rennell. And should you lose your way at Lake Chad Mrs. Patrick Ness will put you right. Then think of the Arctic worthies of whom there were so many that the book is almost a compendium of Arctic travel. Quentin Riley was going about in small boats

but he does not tell us what we all want to know—is there an outboard motor which does not break down and which can be started fairly easily? I should mention Colonel Croft who also contributed. He recognized that in the Arctic or Antarctic when one is wearing sealskin mittens it is best to have two thumbs on each hand. The explanation is that if one thumb gets wet you then put the thumb in the other; he says nothing about the rest of the hand if that gets wet!

To return to other matters, I should like to mention the Everest Expedition which we hope will take place in 1953. We are not sure what has happened to the Swiss party. They may have reached the summit. There have been many conflicting stories in the few official reports in *The Times*, but more often in other newspapers. The reason for that is that *The Times* has bought the Everest news, and must therefore be reticent. While we as sportsmen hope that the Swiss have reached the summit, I must admit that I should be happier if they had not! At any rate, they have made a very great effort. That is clear from the latest telegram, which appeared in *The Times* on June 21; if they have not reached the top there is one more chance for Eric Shipton to do so next year; and I think there will be only one more chance because the Swiss have dispelled the 28,000-foot bogey. It is now only a few hundred feet, probably of very hard climbing, before the summit is reached.

The other expedition to which I would like to refer is Commander Simpson's to the Arctic. He is going out to spend two winters there. That expedition marks the revival of the interest of the Navy in polar exploration, and with the Navy are associated the Army and the Air Force, and I particularly mention the Merchant Navy. The ship will sail under the white ensign and the red. You will have seen that Her Majesty the Queen has expressed a wish to visit Commander Simpson's ship when it comes to the Thames. That reminds one of the pages in Hakluyt's 'Voyages' where we are told that Queen Elizabeth visited Sir Martin Frobisher's ships in 1576. The *Gabriel* and the *Michael* dropped anchor off Greenwich Palace on 15 June 1576 and fired a salute. Hakluyt says the Queen stood at an open window of the Palace and waved her hand, also sending the adventurers a gracious message that she had "good liking of their doings." Let us hope that Queen Elizabeth II's visit will be of similar augury and will be a sign that the spirit of adventure is not only present in the members of the expedition but that adventure and progress are still the privilege of our nation.

Lord RENNELL OF RODD: I regret having to rise after my friend Mr. Butler (otherwise the Chancellor of the Exchequer) has left, because I had one or two remarks to make to him which, no doubt, Mrs. Butler will pass on! They are contained in what I want to say in proposing the health of the Medallists and Guests.

Our guests, and the medallists to whom awards were handed this afternoon by our President, are all adventurers in their several ways of life. Of Mr. Butler I would only say that he is engaged in one of the greatest adventures, in which we are all part of the crew. I would have said to Mr. Butler that I think he has this evening been—before he left for very good reasons I have no doubt—in an extremely equivocal position; he is a Fellow of the Society of many years standing. He is also our Chancellor of the Exchequer and as such is contributing a modest sum, an all too modest sum, to the activities of our Society! I expect that is why he went away, because I would have said that had the sum been translated into terms of modern currency, that subscription would have been very substantially larger. It was, perhaps, because he did not want to hear that that he left!

The guests and the medallists, and many others here, are engaged in a very great adventure. Sir George Thomson spoke of the things of the earth earthy on the one hand, and on the other of people who matter more than things. The history of this Society is a story of people mattering more than things. In the remarks which our President has made it is apparent that what people are still doing, not what they have done, is what matters to us.

Do you recall what the President said about 'Hints to travellers'? He spoke of Mr. Kirwan's predecessor, who when compiling the second edition collected or inveigled twenty to thirty explorers to express their views. Leaving out of account the facetious remarks the President made about some who contributed, Mr. Wordie said that if that second volume were to be compiled today there would be many more. It would be difficult now to find, not how many but how few you could get to contribute to, say, Arctic or Antarctic travel, or African travel. That is the measure of that spirit of adventure which is still with us.

Do you remember—some of you may have read it—the fourth part of Bernard Shaw's quadrilogy, 'Back to Methuselah'? In the last scene, on a darkened stage, Lilith appears speaking to the audience of the thousands of years of the human race that she had experienced. She said how disappointing the human race had been, and on the whole I guess she was right. I cannot now quote the exact words, but the theme was: I will forgive them all the misdeeds they have committed for one thing—their curiosity. There remained, and there remains, not only here but everywhere, the desire to enquire, to know why, not always to go to a place to which nobody has been before—that is more difficult now—but to go back and see why certain things happen, why certain things are done. That is what made Frobisher go on his voyages. That is what made Paul-Émile Victor give rise to the rebirth of Arctic and Antarctic exploration in France. That is the background of the First Counsellor of the French Embassy, M. Jean Le Roy, who is a guest of the Society with Madame Jean Le Roy, and who was a pupil of de Martonne. That is why Tilman received the Gold Medal this afternoon. You can go through the list, not only in geography but in the other sciences. And in that great adventure and exploration which has been Sir George Thomson's, what has been their common quality? Inquisitiveness and curiosity. Dr. G. M. Lees in geology; the map-makers who are trying to make maps better and more cheaply and more quickly; those who are studying the languages and names in countries that are less familiar to us. In all is the back ground of inquisitiveness. I see in our guests and medallists here this evening no lack of that curiosity that Lilith instilled into Eve and that Eve reproduced in the world.

The Headmaster of Harrow in a recent address remarked that we wanted more adventure among the young and less security; that there was too much security and not enough spirit to go abroad. I do not think that is what we see today. I think we see in all walks of life and in all generations a desire to go and look, and to find out for themselves. That happens nationally, internationally, and in every walk of society in every country. Our American friends who are with us this evening, and the many of them who have had close association with the Society, are the first to realize that adventure in every walk of life, so far from being dead, is only just being born. It is the purpose of a Society like ours, with its background and its traditions, to see that that spirit remains, is encouraged and grows. And in so far as it does grow the existence of this Society will have been justified.

Ladies and gentlemen, we have to thank our guests for coming, to give them welcome and to congratulate those among our guests and others who have received medals and awards from the Society. We are particularly glad that so

many of our guests and our medallists come from countries overseas, whether in Europe or in the Antipodes, because it has always been our tradition to recognize that the spirit of adventure knows no bounds of country or continent. I give you the toast of our Medallists and Guests.

M. PAUL-ÉMILE VICTOR in responding said: The last time I was scared was about two months ago when I flew from Peary Land to Thule over the rocky mountains of northern Greenland and over the ice cap in a four-engined plane, a B.17; we flew for four hours with only one engine running smoothly. As everybody knows, one goes to the Arctic for gold! I never anticipated that my gold-digging would, at long last, find its first, and probably last, nugget to-night! And what a nugget! The greatest of all our achievements, for my comrades and myself, seems to me to have definitely proved an important statement made by another Medallist of the Society, a polar explorer and a Frenchman, of whom I think I was a friend and who was certainly my friend, Dr. Charcot. This statement is incidentally not in 'Hints to travellers' but, as you will see, could be extremely valuable to polar explorers. "If you find yourself in a polar region without knowing if it is the Arctic or the Antarctic you have a very good way of finding out—if you find yourself face to face with penguins then you are in the Antarctic, but if it is a polar bear, then you are in the Arctic."

I speak tonight on behalf of the guests and medallists of the Society. The guests have been mainly represented by Mr. Butler, Chancellor of the Exchequer, and I was wondering if he can be called a guest as he has been a Fellow of the Society for twenty-one years, which means fourteen years longer than I have been!

Looking over the list of guests and recipients of awards, past and present, I am impressed and amazed by the wide range of interests of the Royal Geographical Society, and also by the help and assistance given by the Society and its staff to explorers of all nationalities. That range of interests covers mountain climbing, with Mr. Tilman and my friend Professor Finch; colonial survey and mapping with Mr. Wiggins, or should I say Colonel Wiggins; exploration of the sea, Dr. Herdman; geographical work, Mr. Beckett, who is the youngest of those honoured today, and Mr. Webb and Professor Cotton. Also the thousand-and-one nights of Arabian exploration represented by the great explorer Mr. St.John Philby; physics and electric energy by Sir George Thomson; and then there is polar exploration.

I have to thank the Society for many things but I wish to thank it mainly tonight for the spirit of co-operation that I have experienced so often in the eighteen years since I started for the first time for the Arctic.

I would like to add a few words in regard to the co-operation received in general; by "co-operation" I mean in exploration and mainly polar exploration. I feel, and I think that we more or less all feel, the same about Europe; we have to pool our efforts for a European community. Of course for the same reasons I think we should pool our efforts for polar research and exploration.

There are three types of polar expedition: a few members going to different parts with little equipment; or the more traditional type of expedition, like the Queen Maud Land expedition or our own expeditions to the Antarctic or Arctic; or, again, huge expeditions of which I know only two—one by Eric the Red when he went to Greenland a thousand years ago with twenty-four ships, fifteen hundred men and women, cows and horses, and the U.S. Naval Antarctic Expedition of 1947 which was almost as big with thirteen ships and four thousand men.

Of course I am speaking only of the second type of expedition, the more traditional type, when from ten to thirty or thirty-five men go for a winter or

two to the Antarctic or Arctic. We spend a great deal of effort and a lot of money on expeditions of that nature, and I think that if the pooling of that effort and that money could build up a big international expedition, the results of the expedition would be much greater than those that come after a summing up of the individual results of many expeditions. I believe that we shall be pushed to that solution if we do not wish to see only our friends of the United States Navy make great expeditions and achieve results.

I am not only a friend but a lover of dogs and sleds, and one of the things I regret most in my past expeditions, the more recent ones since 1948, is that in four years (it will be five in a few weeks) I was not able to use dogs and sleds on more than about three days. I regret it, but I feel that if an expedition has not sufficient money to procure up-to-date equipment such as snowmobiles, aeroplanes or "weasles" (and has to buy dogs only for its survey work) then the expedition should keep the money until it has accumulated more so as to add up-to-date equipment. It is a waste of time and loss of effort to go without such equipment.

Then, in the same general trend of thought, I would say that if we could pool all our efforts; if, for instance, the overhead expenses of organizations could be shared, the whole thing would be more efficient. Let us organize two expeditions, one in the Arctic and the other in the Antarctic; the overheads for one expedition will probably be the same as for two.

I never knew how to make a speech. I do not know really what the proper thing is to say tonight on behalf of the guests and medallists, and I hope you have not been bored by what I wanted to say about polar exploration. In conclusion, I want to thank very heartily, on behalf of those I represent, the Royal Geographical Society and its President.

The following were elected to Fellowship and Associate Membership of the Society on 14 July 1952

Elections to Fellowship: William Traven Aitken, M.P.; Donald Barton, B.A; John Black; Miss Valerie Evelyn Mary Bowell; Ian Bowler; Dr. Byron Britton Brock; Leonard George Brook; Leslie Clark; Matthew Jason Clayton-Mitchell; Maurice Henry Curtis; Thomas John Davies; Craig Duncan, M.A.; Mrs. Marjory Maureen Filmer Evans; W. Gagen; The Rev. H. B. Garlock; Miss Gertrude M. Gordon; Miss Eleanor Gray; Mrs. Muriel Gray; Allister Grossart; Morris Kenneth Harding; Miss V. A. Janaki, B.LITT.; Alfred Richard Johnson; Rom Landau; Aubrey Victor Lawes, M.A.; The Rev. Harold George Martin, PH.D., TH.D., D.D.; H. I. Matthews, O.B.E., M.C.; Raymond John Mead; George Stuart Pound; Claude Rackett; Caryl Oliver Imbert Ramsden; David S. Stafford; John H. Stevens, B.A.; The Rev. Gunnerius Tollefsen, D.D.; Mrs. Patricia Kathleen Trunfull; The Rev. W. H. Turner, M.A., D.D., D.LITT.; Dr. James Vance; Walter M. Weinberger; Edward Addison Wrangham; The Rev. Fred Zarfas

Election to Associate Membership: Hugh William Lindsay Weir

THE ROYAL GEOGRAPHICAL SOCIETY

Kensington Gore, London, S.W.7

FELLOWSHIP AND ASSOCIATE MEMBERSHIP

The object of the Society being the Promotion and Diffusion of Geographical Knowledge, it has always welcomed to its Fellowship those anxious to further this object by their interest and support, as well as those able to take a more active part in the work of discovery and exploration.

It is provided by Chapter III. § 1. of the Bye-Laws that a candidate for admission to the Fellowship of the Society must be proposed and seconded by Fellows. Further, that a candidate is not to be considered eligible until he has attained the age of twenty-one years, unless he holds a Commission in Her Majesty's Forces or is a matriculated student of a University of the United Kingdom or the Self-Governing British Dominions. Proposal forms can be obtained on application to the Director and Secretary, who will also lend if necessary a List of Fellows.

Chapter V. § 1, of the Bye-Laws provides that—

(a) *Every Fellow (other than those elected under Chapter III. § 6) shall, except as provided below, be required to pay either on Election Five pounds as Entrance Fee and Three pounds as Annual Subscription for the current year and thereafter an Annual Subscription of Three pounds due on January 1 in each year; or instead of an Entrance Fee on election an enhanced Annual Subscription of Four pounds for the current and four following years, and thereafter Three pounds; or a single Compounding Fee of Sixty pounds.*

For Fellows who are under the age of 25 years on election the Entrance Fee shall be reduced from Five pounds to Two pounds; or alternatively the enhanced Annual Subscription of Four pounds shall be payable for the current year and for two following years instead of for five.

Fellows who are on election the wives or husbands of Fellows shall pay no Entrance Fee.

Fellows who are on election the widows or widowers of Fellows shall pay no Entrance Fee if elected within one year of the decease of husband or wife.

(b) *Fellows may compound for their Annual Subscriptions at any subsequent time by a payment of £60 (sixty pounds) less £2 (two pounds) for each Annual Subscription paid in terms of five with a minimum of £20 (twenty pounds) after 25 payments.*

(c) *No Fellow shall be entitled to vote or to enjoy any privilege of the Society while in arrear.*

Chapter IIIa of the Bye-Laws, covering the terms of Associate Membership, provides that—

1. *Candidates must be not less than 17 and not more than 20 years of age. They must be recommended by a Fellow, University or School authority.*

2. *Subscription shall be £2 per annum without Entrance Fee.*

3. *On attaining the age of 21 Associate Members become eligible for Fellowship. The Entrance Fee of £5 shall be waived provided they have been Associate Members for 3 years. Otherwise Associate Membership shall cease at the age of 21.*

All subscriptions are payable in advance, on the 1st of January in each year.

The privileges of a Fellow or Associate Member include admission (with one Friend) to all ordinary Meetings of the Society, and the use of the Society's House, Library, and Map-room. Each Fellow is also entitled to receive a copy of all the Society's Periodical Publications. Associate Members have the choice of receiving either *The Geographical Journal* or *The Geographical Magazine*. Associate Members may not describe themselves as F.R.G.S. and have no vote at Annual or Special General Meetings.

A pamphlet giving a brief History of the Society, with a description of its Work and Publications, its Charter and Bye-Laws, and an illustrated account of its House in Kensington Gore, can be sent to anyone interested on application to the Director and Secretary.

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SVALBARD
CENTRAL VESTSPITSBERGEN

From surveys and compilation by the
Cambridge Spitsbergen Expedition
1949

Scale 1 : 125,000

Miles 1 0 1 2 3 4

Kilometres 1 0 1 2 3 4 5 6

Heights in metres

ISFJORDEN
Sassenfjorden
Deltaneset
Adventfjorden
Longyearbyen
Lykta
DICKSONFJORDEN
Abeltoppen
Gyldénfjellet
Watsontoppen
Natharstdalen
Natharstelva
Rauduatnet
Klinamurbreen
Monchetterbreen
Southamptonbreen
Citadellet
Kinanderfjellet
Karnakfjellet
Kulmdalen
Gonvillebreen
Calusbreen
Lagercrantzberget
Triungen
Hugindalen
Stensiobreen
Hoelbreen
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Torfjellet
Fiskekløfta
Bredsdorffberget
Heimenfjellet
Kapp Wijk
Idodalen
Ibsenfjella
Kongressfjellet
Skansdalen
Skansen
Hut
Draschedalen
Sturefjellet
Tschermak-fjellet
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Saurieelva
Högskulefjellet
Skansbukta
Kapp Fleur de Lys
78° 30′
Nottedalen
Strudentdalen
Rotunda-fjellet
Rundodden
Kapp Thordsen
Gåsøyane
15° 30′
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Uranusfjellet
Furystakken
Ramsayfjellet
Oberonhamaren
Heclastakken
Framstakken
Hoglandvatnet
Sedgwickjøkelen
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GIPLAND
LEIFFLERBREEN
LOMONOSOVFONNA
SASSENFJORDEN
TEMPELFJORDEN
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17°00′
17°30′
78°30′

CENTRAL VESTSPITSBERGEN
Harland

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- Expédition Française au Spitzberg 1946
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- Cambridge Spitsbergen Expedition 1930
- Norwegian photogrammetric survey (c. 1925) (from which the graticule of this map is also derived)

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SVALBARD

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Dicksonfjorden

DICKSONLAND

Pyramiden

Nordenskiöldbreen

Brucebyen

BÜNSOWLAND

Billefjorden

ISFJORDEN & WIJDEFJORDEN

Sassenfjorden

Deltaneset

Adventfjorden

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Abeltoppen

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Lagercrantzbergen

Calusbreen

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Zeipeldalen

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VETERANEN

CHYDENIUSBREEN

Chydeniusrieila

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79° 00′

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Pyramiden

Estheriahaugen

Mimerdalen

Reuterskiöld-fjellet

Elisbreen

Berrillbreen

Santabukta

Ferriermorene

Kerrietta

Kerrietta

Karsteya

LOMONOSOVFONNA